# Modicon M340
## BMX NOC 0401
## Ethernet Communication Module
## User Manual

10/2014

S1A34009.05

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# Safety Information

## Important Information

### NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

**⚠ DANGER**

**DANGER** indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

**⚠ WARNING**

**WARNING** indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

**⚠ CAUTION**

**CAUTION** indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

***NOTICE***

***NOTICE*** is used to address practices not related to physical injury.

## PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

# About the Book

## At a Glance

### Document Scope

This manual describes the use of the Modicon M340 BMX NOC 0401 Ethernet communication module. This manual describes the creation of a complete configuration. The features and functions of the module are described in the course of constructing this configuration.

The specific configuration settings contained in this manual are intended to be used for instructional purposes only. The settings required for your specific configuration ill differ from the examples presented in this manual.

### Validity Note

The module described in this document can requires Unity Pro version 5.0 or later.

### Related Documents

For additional information, refer to the online help files for the Unity Pro software, and to the following technical publications:

| Title of Documentation | Reference Number |
|---|---|
| Advantys STB EtherNet/IP Network Interface Applications Guide | 31008204 (English), 31008205 (French), 31008206 (German), 31008207 (Spanish), 31008208 (Italian) |

You can download these technical publications and other technical information from our website at www.schneider-electric.com.

# Chapter 1
# Installation

## Overview

The Ethernet communication module serves as the interface between a M340 PLC and other Ethernet network devices by means of either the EtherNet/IP or the Modbus TCP communication protocol. This chapter shows you how to install the module by:

- inserting it into a PLC backplane
- connecting it to an Ethernet network
- installing the Unity Pro Ethernet Configuration Tool software

## What Is in This Chapter?

This chapter contains the following topics:


| Topic | Page |
|---|---|
| Physical Description of the BMX NOC 0401 Module | 14 |
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| Communication Specifications | 19 |
| Mounting the BMX NOC 0401 Module | 21 |
| Installing Unity Pro Ethernet Configuration Tool Software | 23 |
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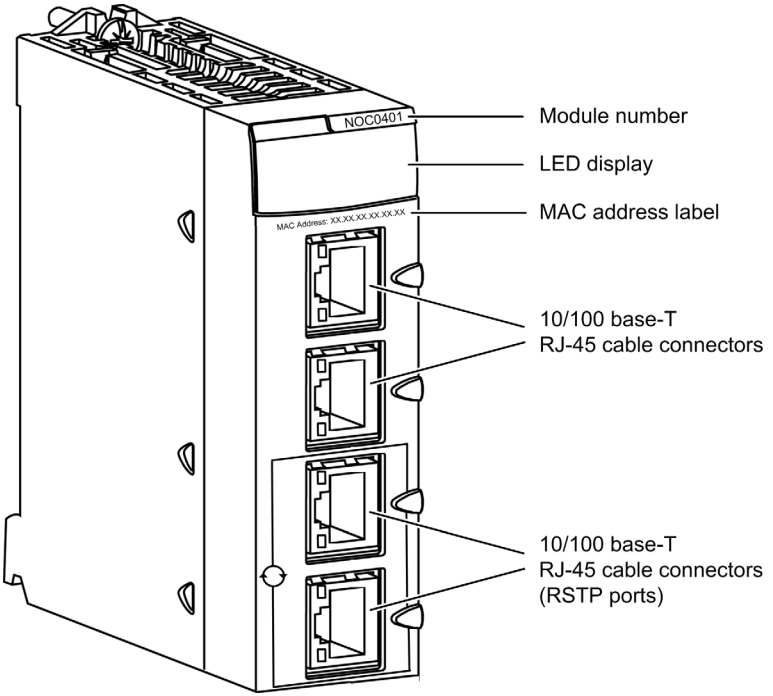
# Physical Description of the BMX NOC 0401 Module

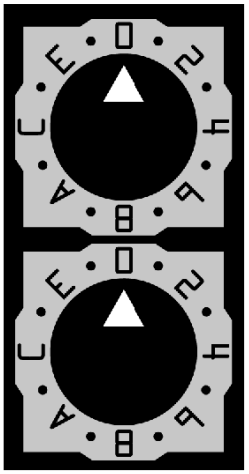
## Front

The front of the module presents the following features:



## Rotary Switches

The back of the BMX NOC 0401 presents two rotary switches, which you can use to specify how the module will obtain its IP address.

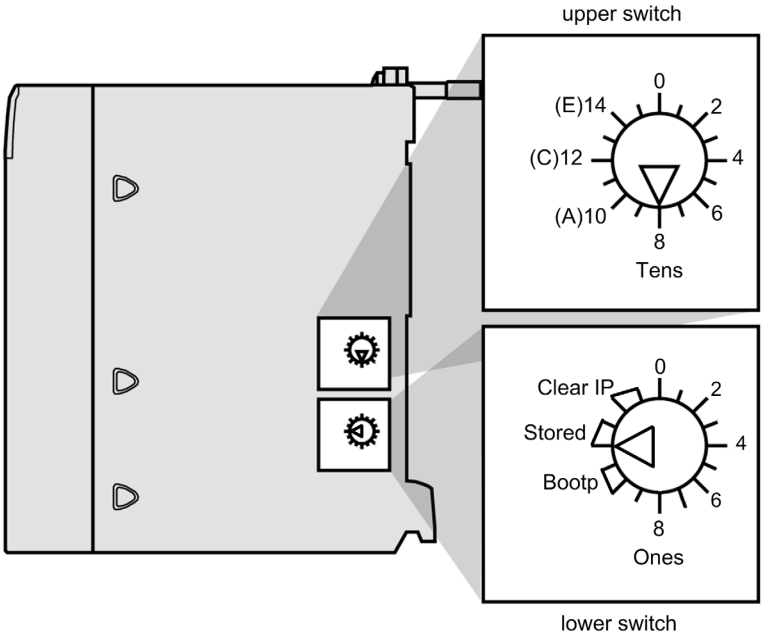



The settings of these two rotary switches work together to specify the source of the module's IP address, as follows:

| Setting | Description |
|---|---|
| Upper switch: | |
| 0...9 | Tens value (0, 10, 20...90) for the device name setting. It is added to the ones value on the lower switch to identify the module to a DHCP server. |
| A...F | Tens value (100, 200, 300...150) for the device name setting. It is added to the ones value on the lower switch to identify the module to a DHCP server. |
| Lower switch: | |
| 0...9 | Ones value (0, 1, 2...9) for the device name setting. It is added to the tens value on the upper switch to identify the module to a DHCP server. |
| A + B | BootP[1]:The module obtains its IP address from a BootP server. |
| C + D | Stored[1]: The module uses the IP address configured in the application. |
| E + F | Clear IP[1]: The module applies its default IP address. |
| 1. The lower switch alone determines module behavior. The upper switch is ignored. | |

## Switch Labels

The right side of the module displays two labels explaining the choice of rotary switch settings, as depicted below.




## LEDs

The BMX NOC 0401 communication module presents the following LED indicators:

- RUN (running)
- ERR (detected error)
- MS (module status)
- NS (network status)
- ETH STS (Ethernet status)

In addition, each Ethernet port presents the following two LED indicators:

- LNK (link)
- ACT (activity)

For a description of these LEDs, and how to use them to diagnose the communication module, refer to the topic LED Indicators for the Ethernet Communication Module *(see page 306)*.

# Module Specifications

## Specifications

BMX NOC 0401 specifications include:

| | |
|---|---|
| **Ports** | |
| Communication Ports | Four auto-sensing 10/100Base-T shielded twisted pair (RJ-45 connector) ports. |
| **Electrical** | |
| Bus Current Required | @3.3V: 550 mA |
| Power Dissipation | 1.9 W |
| Fuse | None |
| **Operating Conditions** | |
| Temperature | 0...60° C |
| Humidity | 0...95% Rh non-condensing @ 60° C |
| Altitude | 2000 m (6561.68 ft) |
| **Storage Conditions** | |
| Temperature | –40...+85° C |
| Humidity | 0...95% Rh non-condensing @ 60° C |
| Altitude | 3000 m (9842.52 ft) transport |

## Software Compatibility

The Ethernet communication module is compatible with Unity Pro programming software version 5.0 and later.

## Standards

The Ethernet communication module complies with the following standards:

- UL 508
- CSA 22.2-142
- CSA 22.2-213
- CE
- EMI EN55011
- EN61131-2
- IEC61131-2
- IEEE 802.3 2002
- ODVA

## Communication Modules per Station

The maximum number of communication modules — including but not limited to BMX NOC 0401 Ethernet communication modules — you can install in a single station is determined by the CPU serving that station

| CPU | Maximum Number of Communication Modules per Station |
|---|---|
| BMX P34 1000 | 2 |
| BMX P34 2000 | 3 |
| BMX P34 2010 | 3 |
| BMX P34 20102 | 3 |
| BMX P34 2020 | 3 |
| BMX P34 2030 | 3 |
| BMX P34 20302 | 3 |

**NOTE:** If you use the embedded Ethernet port with the BMX P34 2••• copro, the maximum number of communication modules per station is 2.

# Communication Specifications

## Introduction

The following specifications describe both the I/O communication and the explicit messaging capacities of the BMX NOC 0401.

## I/O Communication Specifications

The Ethernet communication module presents the following I/O communication features:

| Communication type | Feature | Capacity |
|---|---|---|
| EtherNet/IP (CIP Implicit Messaging) | Scanner | |
| | Maximum number of devices | 128 devices (125 devices as scanner + 3 devices as adapter) shared with Modbus TCP |
| | Maximum message size | 512 bytes |
| | Adapter | |
| | Maximum number of instances | 3 adapter instances |
| | Maximum number of connections | 2 connections per instance |
| | Maximum message size | 511 bytes including header |
| | Inputs | 505 bytes excluding header |
| | Outputs | 509 bytes excluding header |
| Modbus TCP (Modbus Scanner) | Maximum number of registers | |
| | Read | 125 registers |
| | Write | 120 registers |
| | Maximum number of devices | 128 devices shared with EtherNet/IP |
| | Maximum message size | |
| | Read | 250 bytes (125 words) excluding header |
| | Write | 240 bytes (120 words) excluding header |

## Explicit Messaging Specifications

The Ethernet communication module presents the following explicit messaging features:

| Communication type | Feature | Capacity |
|---|---|---|
| EtherNet/IP (CIP Explicit Messaging) | Client | |
| | Maximum number of simultaneous connections | 16 connections |
| | Maximum number of concurrent requests | 16 requests, shared with Modbus TCP |
| | Server | |
| | Maximum number of simultaneous connections | 32 connections |
| | Maximum messaging size | 1023 bytes |
| Modbus TCP (Modbus Scanner) | Client | |
| | Maximum number of simultaneous connections | 16 connections |
| | Maximum number of concurrent requests | 16 requests, shared with EtherNet/IP |
| | Server | |
| | Maximum number of simultaneous requests | 128 requests |
| | Maximum number of simultaneous connections | 32 connections |
| | Maximum message size | |
| | Read | 250 bytes (125 words) excluding header |
| | Write | 240 bytes (120 words) excluding header |

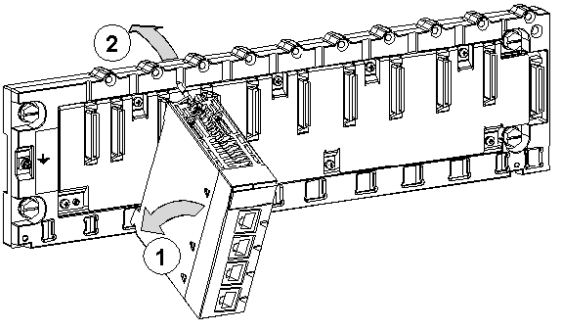
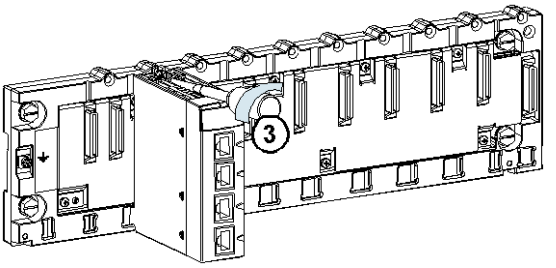
# Mounting the BMX NOC 0401 Module

## Tools Required

One medium sized (size 2) Phillips-head screw driver.

## Mounting the Module

The module can be mounted in any of the racks of the Modicon M340 system. It can be installed in any available slot (except in the offset X Bus racks). To mount the communication module:

| Step | Action | Illustration |
|---|---|---|
| 1 | Position the locating pins (situated at the bottom part of the rear of the module) in the corresponding slots. |  |
| 2 | Swivel the module upwards toward the top of the rack, so that the back of the module sits flush with the rack.<br>**NOTE:** Before positioning the pins, remove the pins protective cover. | |
| 3 | Tighten the screw to hold the module in place on the rack.<br>**NOTE:** The tightening torque is 1.5 N.m (13.3 lb-in). |  |

## Wiring

**⚠ WARNING**

**HAZARD OF ELECTRICAL SHOCK OR BURN**

Connect the ground wire to the protective ground (PE) terminal before you establish any further connections. When you remove connections, disconnect the ground wire last. The Ethernet cable shield must be connected to PE ground at the Ethernet switch.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

The Ethernet communication module communicates over an industrial Ethernet network through any one of four RJ45 connectors located on the front of the module.

- Use the top two ports (ports 1 and 2) to connect to end devices.
- Use the bottom two ports (ports 3 and 4)—which support the RSTP redundancy protocol—to connect to the local area networks, for example, a ring.

# Installing Unity Pro Ethernet Configuration Tool Software

## Overview

Accessing Unity Pro Configuration Tool Software depends on the version of Unity Pro that you are using:

- Unity Pro version 6.0 and higher: The module configuration software is already included in the Unity Pro installation.
- Unity Pro version 5.0: You need to install the Unity Pro Ethernet Configuration Tool software, which you can obtain from the following website: http://www.global-download.schneider-electric.com/8525773E00058BDC/all/DA00A87B8BB30386852577940058D66C

## Installing Unity Pro Ethernet Configuration Tool Software for Unity Pro Version 5.0

To install this software, navigate to navigate to the root of the installation files and run the file **Setup.exe**.

The setup process displays the following setup screens:

| Step | Screen | Description |
|---|---|---|
| 1 | Welcome | Click **Next** to continue. |
| 2 | ReadMe and Release Notes Display | Indicate whether to display the ReadMe file.<br>Click **Next** to continue. |
| 3 | ReadMe | (Optional) Displays the ReadMe file, if selected above.<br>Click **Next** to continue. |
| 4 | License Agreement | Displays the software license.<br>Select **I accept...**, then click **Next** to continue. |
| 5 | Customer Information | Enter the following data:<br>● your first and last names<br>● company name<br>● identify for whom the software is installed:<br>  ● anyone who uses this computer<br>  ● only for yourself<br>Click **Next** to continue. |
| 6 | Destination Folder | Identify where the application will be installed. Either:<br>● Accept the default path<br>● Click **Change...** and specify a new path<br>Click **Next** to continue. |
| 7 | Ready to Install | Click **Next** to continue. |
| 8 | Status | Progress bar indicates the status of the installation.<br>When complete, click **Next** to continue. |
| 9 | Install Complete | Click **Finish**. |

The installation process described above copies the following objects to your PC:

- the Unity Pro Ethernet Configuration Tool
- a Generic EtherNet/IP DTM
- a Generic Modbus TCP DTM

**NOTE:** A DTM is a small software driver that defines and enables a device.

## Updating Hardware Catalog

For installations of Unity Pro version 5.0 and higher, the next step is to update the **Hardware Catalog**. Updating the **Hardware Catalog** adds your new Ethernet communication module to the list of available modules and devices that you can add to your Unity Pro application.

Refer to the topic Updating the Unity Pro Hardware Catalog *(see page 120)* for step-by-step instructions.

# UnInstalling the Ethernet Configuration Tool

## Introduction

Use the **Add or Remove Programs** utility provided by the Windows™ operating system to uninstall the Unity Pro Ethernet Configuration Tool.

To completely uninstall the Ethernet Configuration Tool, remove each of the following three DTMs, one at a time:

Generic EtherNet/IP DTM

Generic Modbus TCP DTM

Unity Pro Ethernet Configuration Tool

## Un-Installing Ethernet Configuration Tool DTMs

To remove the three Ethernet Configuration Tool DTMs:

| Step | Action |
|---|---|
| 1 | Open the Windows Control Panel: **Start** →**Settings** →**Control Panel**. |
| 2 | In the **Control Panel**, double click on **Add or Remove Programs**. |
| 3 | In the **Add or Remove Programs** window, select the **Change or Remove Programs** page. |
| 4 | Select the first of the three DTMs to remove (for example, the **Generic EtherNet/IP DTM**), then click **Remove**. |
| 5 | Repeat step 4 for each of the remaining 2 DTMs: **Generic Modbus DTM** and **Unity Pro Ethernet Configuration Tool**. |

# Chapter 2
# Configuring the Ethernet Communication Module

## Overview

This chapter shows you how to use Unity Pro programming software to select and configure the Ethernet communication module.

**NOTE:** The instructions presented in this chapter include specific choices made for a sample project. Your Unity Pro project may include different choices that are appropriate for your specific configuration.

## What Is in This Chapter?

This chapter contains the following sections:


| Section | Topic | Page |
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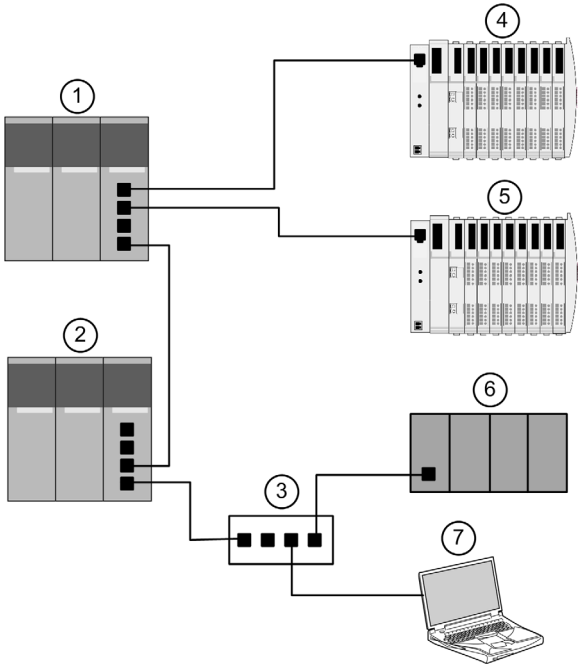
| 2.2 | Creating a Project in Unity Pro | 30 |
| 2.3 | The Unity Pro FDT/DTM Interface | 39 |
| 2.4 | Channel Properties | 58 |
| 2.5 | Ethernet Services | 72 |
| 2.6 | Security | 100 |
| 2.7 | Configuring the Ethernet Communication Module as an EtherNet/IP Adapter | 101 |

# Section 2.1
## Ethernet Network Configuration Example

## The Ethernet Network Example

### The Ethernet Network

This manual describes the creation of a complete Ethernet network configuration for the following topology:




**1** Primary PLC incorporating the BMX NOC 0401 Ethernet communication module
**2** A secondary PLC that “listens” to the scan of the primary PLC local slave by the third-party scanner
**3** Ethernet managed switch
**4** Advantys STB island, with an STB NIC 2212 EtherNet/IP network interface module plus 8 I/O modules
**5** Advantys STB island, with an STB NIP 2212 Modbus TCP network interface module plus 8 I/O modules
**6** Third-party PLC that scans a local slave in the primary PLC (1)
**7** PC equipped with both Unity Pro configuration software (upgraded with the Ethernet Configuration Tool that ships with the BMX NOC 0401 Ethernet communication module) and Advantys configuration software, used to configure communication settings for Ethernet communication module in the primary PLC (1) and the remote network interface modules on the STB I/O islands (4 and 5)

## Multiple Roles of the PLC and Ethernet Communication Module

The PLC, and in particular the BMX NOC 0401 Ethernet communication module, can be configured to simultaneously perform multiple roles with respect to other network devices. In this sample network, you will learn how to configure the communication module to operate as:

- a scanner of devices that use the EtherNet/IP (4) and the Modbus TCP (5) protocols
- an adapter—also known as a local slave—that produces output data that both the remote third-party PLC (6) and secondary PLC (2) can read as input data
- a DHCP server that provides IP address settings to other devices on the Ethernet network
- an FDR server that provides operational settings to devices on the Ethernet network that also receive their IP address from the DHCP server, above

# Section 2.2
## Creating a Project in Unity Pro

### Overview

This section shows you how to add modules—including the BMX NOC 0401 Ethernet communication module—to your project, using Unity Pro.

**NOTE:** For detailed information about how to use Unity Pro, refer to the online help and documentation DVD that come with Unity Pro.

### What Is in This Section?

This section contains the following topics:


| Topic | Page |
|---|---|
| Creating a Project in Unity Pro | 31 |
| Configuring the Size and Location of Inputs and Outputs | 36 |

# Creating a Project in Unity Pro

## Introduction

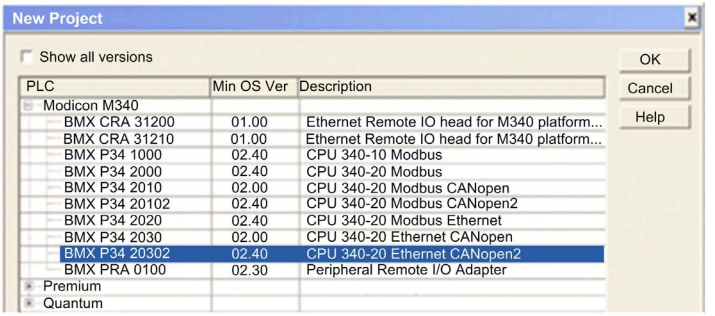
This topic shows you how to create a new Unity Pro project, and add to the new project the following components:

- a CPU
- a power supply
- a BMX NOC 0401 Ethernet communication module

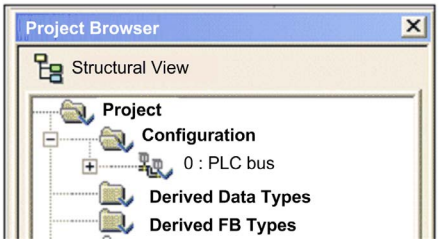
**NOTE:** The following example uses Unity Pro version 7.0, or higher.

## Creating and Saving a New Unity Pro Project

Use Unity Pro to create a new project. The following steps describe the creation of a project for the sample network:

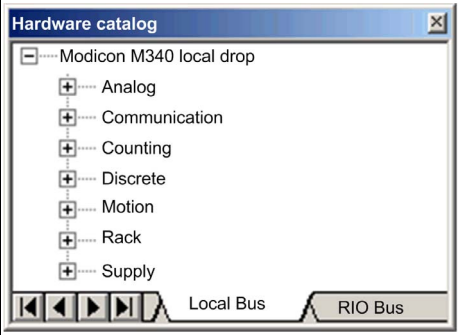
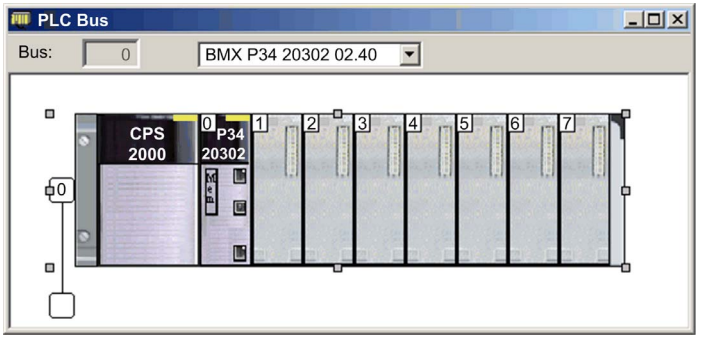
| Step | Action |
|---|---|
| 1 | Open Unity Pro. |
| 2 | In the Unity Pro main menu, select **File** →**New...**.<br>The **New Project** window opens displaying a list of Schneider-Electric controller types. |
| 3 | In the **New Project** window, expand the Modicon M340 node to select a CPU.<br>  <br>In this example, select the BMX P34 20302 Ethernet CANopen2 controller.<br>**NOTE:** By selecting the BMX P34 20302 Ethernet CANopen2 controller, you can later select the BMX NOC 0401.2 Ethernet communication module. |

New Project
Show all versions
OK
Cancel
Help
PLC
Min OS Ver
Description
Modicon M340
BMX CRA 31200 01.00 Ethernet Remote IO head for M340 platform...
BMX CRA 31210 01.00 Ethernet Remote IO head for M340 platform...
BMX P34 1000 02.40 CPU 340-10 Modbus
BMX P34 2000 02.40 CPU 340-20 Modbus
BMX P34 2010 02.00 CPU 340-20 Modbus CANopen
BMX P34 20102 02.40 CPU 340-20 Modbus CANopen2
BMX P34 2020 02.40 CPU 340-20 Modbus Ethernet
BMX P34 2030 02.00 CPU 340-20 Ethernet CANopen
BMX P34 20302 02.40 CPU 340-20 Ethernet CANopen2
BMX PRA 0100 02.30 Peripheral Remote I/O Adapter
Premium
Quantum

| Step | Action |
|---|---|
| 4 | Click **OK**. Unity Pro displays the **Project Browser**, below.<br>  |
| 5 | To save the project, select **File** →**Save**. The **Save As** dialog opens. |
| 6 | In the **Save As** dialog, type in a **File name**—which will be the name of your Unity Pro project—then click **Save**. Unity Pro saves your project to the specified path location.<br>**NOTE:** You can change the default location Unity Pro uses to store project files. Before saving your project:<br>**1** Select **Tools** →**Options**. The **Options Management** window opens.<br>**2** In the left pane, navigate to **Options** →**General** →**Paths**.<br>**3** In the right pane, type in a new path location for the **Project path**. You can also edit the:<br>● Import/Export file path<br>● XVM path<br>● Project settings templates path<br>**4** Click **OK** close the window and save your path edits. |

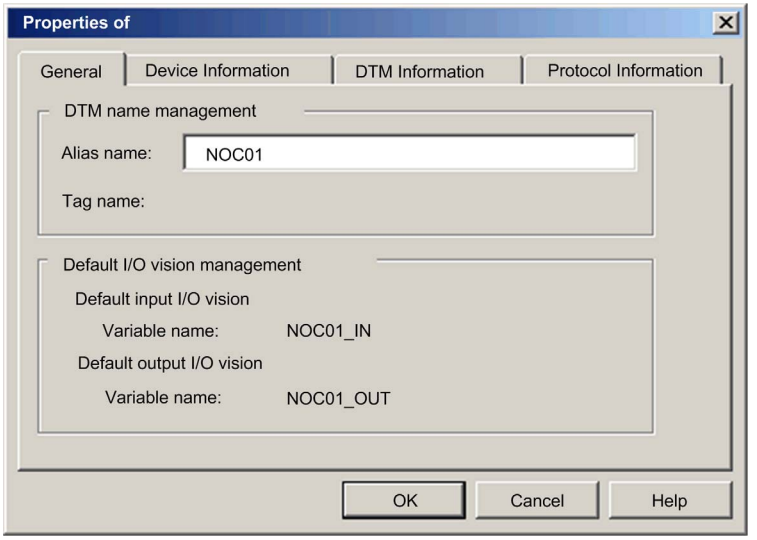
## Adding a Power Supply to the New Unity Pro Project

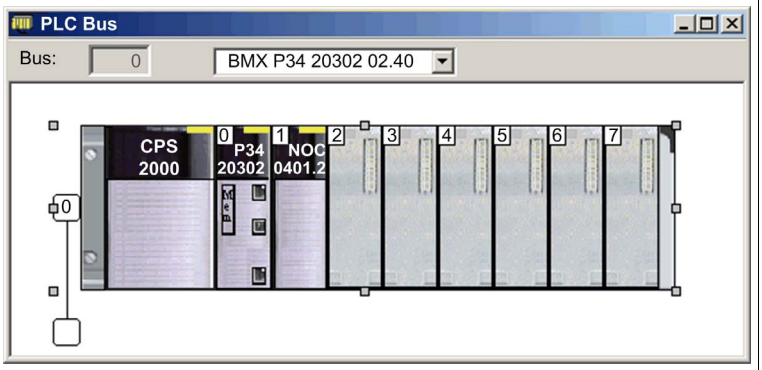
When you added the CPU to the project, above, Unity Pro may also have added a power supply to the project. If not, the next step is to manually add a power supply to your Unity Pro project:

| Step | Action |
|---|---|
| 7 | In the **Project Browser**, double click **0 : PLC bus**. Unity Pro displays both the:<br>● **Local Bus** window with the selected CPU in the second position, and<br>● **Hardware catalog** displaying the **Local Bus** tab, below:<br>  |
| 8 | In the **Hardware catalog**, under the **Supply** node, use your mouse to select then drag a BMX CPS 2000 power supply to the first position in the rack.<br>  |
| 9 | In the **File** menu, select **Save**, to save your edits.<br>**NOTE:** Schneider-Electric recommends that you periodically save your changes as you make edits. |

## Adding an Ethernet Communication Module to the New Unity Pro Project

Next, add an Ethernet communication module to your project:

| Step | Action |
|---|---|
| 10 | Returning to the **Hardware catalog**, under the **Communication** node, use your mouse to select then drag a **BMX NOC 0401.2** Ethernet communication module to an open slot in the rack—in this example, slot 2.<br>**NOTE:** You can select the **BMX NOC 0401.2** only after:<br>● selecting the **BMX P34 20302** CPU for the project, and<br>● upgrading the **BMX NOC 0401** module firmware to version 2.0 or higher<br>When you drop the communication module into the rack, Unity Pro opens the communication module **Properties** window. |
| 11 | In the **General** page of the module properties window, type in an alias name for the communication module: **NOC01**:<br>  <br>When you change the alias name, Unity Pro changes the base input and output type and variable names to match the edited alias name.<br>**NOTE:** Schneider Electric recommends that you assign a unique alias name to each communication module.This practice helps you distinguish between modules of the same type. |
| 12 | In the **File** menu, select **Save**, to save your edits. |

| Step | Action |
|---|---|
| 13 | Click **OK** to close the **Properties** window. The Local Bus now displays the three modules you have added:<br>  |
| 14 | The next step is to configure the located memory space in the CPU for the communication module's inputs and outputs *(see page 36)*. |

# Configuring the Size and Location of Inputs and Outputs

## Overview

Use the **Configuration** page of the Ethernet communication module's **Properties** window to configure:

- the size and starting position of inputs
- the size and starting position of outputs

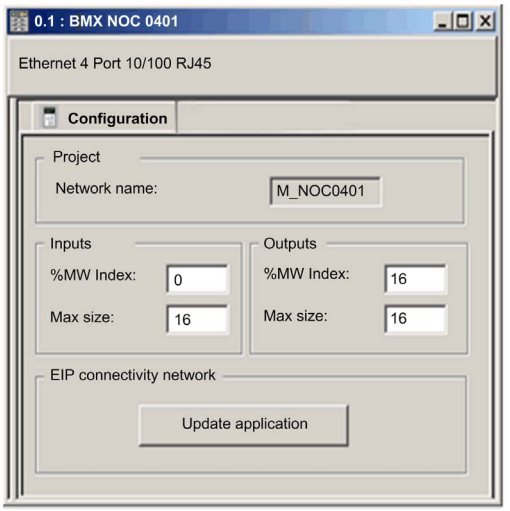
The following steps present one example of how to configure the size and location of inputs and outputs. Your own project configuration may differ.

## Setting Input and Output Memory Addresses and Naming the Module

The **Properties** window opens when you double-click the left mouse button on the image of the BMX NOC 0401 communication module in either the **Local Bus** window, or the **Project Browser**.

When you select the **Configuration** page, it displays the network, or Alias, name. This is the name assigned to the network channel when the communication module was added to the project.

Use the **Configuration** page to edit the communication module inputs and outputs, as follows:




To input the above settings, take the following steps:

| Step | Action |
|---|---|
| 1 | In the module's **Properties** window, select the **Configuration** page. |
| 2 | Type in the size and starting position of the inputs and outputs, as follows: |
| | In the **Inputs** area:<br>● In the **%MW index** field, type in a starting address for inputs, in this example: **0**.<br>● In the **Max size** field, type in the maximum number of 16-bit words dedicated to inputs, in this example:**16**. |
| | In the **Outputs** area:<br>● In the **%MW index** field, type in a starting address for outputs, in this example: **16**.<br>● In the **Max size** field, type in the maximum number of 16-bit words dedicated to outputs—in this example: **16**. |
| | **Notes:**<br>● Locate the inputs and outputs at the beginning of a 4-byte (or 2 word) range. Because address numbering in the M340 platform is zero-based, verify that **%MW index** input and output settings are configured to start at an even number.<br>● Allocate separate non-overlapping space to inputs and outputs.<br>● Unity Pro automatically reserves space for two arrays of 32 bytes, as follows:<br>  ● for connection health bits *(see page 187)*, located at the beginning of the space configured for inputs<br>  ● for connection control bits *(see page 191)*, located at the beginning of the space configured for outputs<br>● Confirm that the %MW space assigned for both inputs and outputs is available in the CPU. For more information, refer to the Unity Pro help file topic *Processor Configuration Screen*. |

| Step | Action |
|---|---|
| 3 | In Unity Pro select **Edit** →**Validate** (or click the **Validate** button) to save the address and size settings for inputs and outputs.<br>**NOTE:** After you validate module settings for the first time, the module name cannot be edited. If you subsequently decide to change the module name, delete the existing module from the configuration, then add and rename a replacement module. |

## Completing the Ethernet Network Configuration

After configuring settings for inputs and outputs, the next step is to configure the communication module settings beginning with its **Channel Properties** and then configure remote Ethernet network devices *(see page 115)*.

**NOTE:** After you input configuration settings for the communication module and remote devices, return to the **Configuration** page of the Ethernet communication module's **Properties** window and click the **Update application** button. This creates derived data type (DDT) variables *(see page 182)* that display the following information and commands for your Unity Pro project:

- connection health bits, that display the status of each connection
- connection control bits, you can use to toggle each connection on and off
- the value of input and output items
- module and device configuration settings
- free memory space that has been reserved, but not yet allocated

# Section 2.3
# The Unity Pro FDT/DTM Interface

## Overview

The section describes the use of DTMs within Unity Pro.

## What Is in This Section?

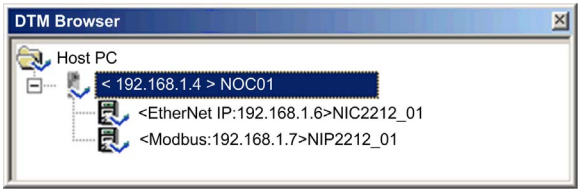
This section contains the following topics:


| Topic | Page |
|---|---|
| DTM Browser | 40 |
| DTM Browser Menu Commands | 42 |
| Field Bus Discovery Service | 48 |
| Device Editor | 52 |
| Configuring Properties in the Device Editor | 54 |
| Uploading and Downloading DTM-Based Applications | 56 |

# DTM Browser

## Overview

The **DTM Browser** displays a hierarchical list of DTMs—in the form of nodes on a connectivity tree—that have been added to your Unity Pro project. Each DTM node represents an actual module or device in your Ethernet network.




## Node Types

There are 3 types of DTM nodes:

- Communication DTMs:
  - Any COM DTM can be plugged directly under the root node (Host PC) at the 1st level
  - A COM DTM can support Gateway DTMs or Device DTMs as children if their protocols are compatible
- Gateway DTMs:
  - A Gateway DTM can support other Gateway DTMs or Device DTMs as children if their protocols are compatible.
- Device DTMs:
  - A Device DTM does not support any child DTMs

## Node Names

Each DTM has a default name when inserted into the browser. The default name consists of the following elements:

<Channel: Address> Device Name

Where:

| Element | Description |
|---|---|
| channel | This is the name of the channel communication media, to which the device is plugged in. This name is read from the DTM and is set by the device vendor.<br>Example: EtherNet/IP, Modbus |
| address | The bus address of the device, which can be:<br>● The connection point on its parent gateway network<br>● The slot number in the modular device parent internal bus<br>Example: the device IP address |
| device name | The default name is determined by the vendor in the device DTM, but can be edited by the user. |

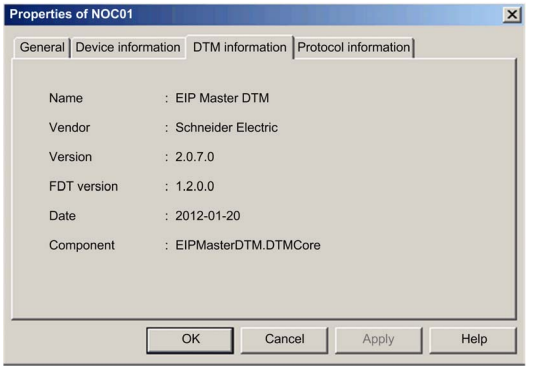
## Node Status

The **DTM Browser** displays the status of each DTM node in the connectivity tree, as follows:.

| Status | Description |
|---|---|
| Built / Not-built | A blue check mark superimposed on a device icon indicates that node, or one of its sub-nodes, is not built. This means that some property of the node has changed, and the information stored in the physical device is no longer consistent with the local project. |
| Connected / Disconnected | A connected DTM is denoted in **bold** text. An unconnected DTM appears in plain text.<br>**NOTE:**<br>● Connecting a DTM to its physical device automatically connects higher level parent nodes up to the root node.<br>● Disconnecting a DTM from its physical device automatically disconnects its lower level child nodes.<br>**NOTE:** Connecting or disconnecting a DTM to or from its device does not also connect or disconnect Unity Pro to or from the PLC. DTMs can be connected/disconnected while Unity Pro is either offline or online. |
| Installed / Not-installed | A red X superimposed on a device icon indicates the DTM for that device is not installed on the PC. |

## Handling Invalid Nodes

As indicated above, a red X superimposed on a node indicates the DTM for that node is not installed on the PC. To resolve this situation, click the right mouse button on the node to open a pop-up menu with the following two commands:

| Command | Description |
|---|---|
| Delete | Removes the selected node (and its sub-nodes) from the **DTM Browser**. |
| Properties | Opens the following dialog, which you can use to identify the name of the missing DTM:<br>  |

# DTM Browser Menu Commands

## Overview

The **DTM Browser** includes a pop-up, contextual (right-click) menu that displays commands for the currently selected DTM. The list of available commands consists of:

- universal commands, as determined by the selected node level:
  - host PC node (level 1)
  - communication module node (level 2)
  - remote device node (level 3)
- device-specific commands, as determined by the device DTM

## Host PC Node Commands

The **Host PC** node contextual menu includes the following commands:

| Name | Description |
|---|---|
| Add[1] | Opens the **Add** dialog — containing a subset of the **Hardware Catalog**, allowing the selection of a communication module DTM. |
| Check DTM devices[1] | Checks the current project for invalid DTMs or DTMs that are not installed in the PC. If the results of the check include invalid or not-installed DTMs, they are displayed in the **User errors** tab in the information window and a red X is superimposed over their icons in the **DTM Browser**. |
| DTM services | Displays the communication DTMs selection, as well as the device topology, their respective IP addresses, and connection state. In this dialog, for each device you can connect, disconnect, load from devices, or store to devices. You can also choose to stop communication or continue activity when detected errors occur. |
| DTM hardware catalog | Displays the **DTM catalog** tab of the **Hardware Catalog** dialog. |
| Expand all[2] | Displays every DTM in the project. |
| Collapse all[2] | Displays only the communication DTMs in the project. |
| 1. This command also appears in the Unity Pro **Edit** menu.<br>2. This command also appears in the Unity Pro **View** menu. | |

## Communication Module and Remote Device Node Commands

The **DTM Browser**'s contextual menu has the following items:

| Name | Description |
|---|---|
| Open[1] | This opens the **Device Editor** for the selected communication module.<br>**NOTE:** Double-clicking the left mouse button on the DTM in the **DTM Browser** also opens this window. |
| Add [1] | This opens the **Add** dialog, displaying a subset of the **Hardware Catalog**, allowing the selection of a DTM.<br>**NOTE:** Unity Pro filters the content of the **Add** dialog, so that it displays only DTMs that are compatible with the selected DTM selected. |
| Delete[1] | If the selected DTM allows this function, this deletes the selected DTM and its sub-node DTMs from the DTM connectivity tree.<br>Deletion from the DTM connectivity tree does not affect the DTM's link to the I/O scanning table. |
| Field Bus Discovery | This scans the connected physical devices to create the corresponding field bus topology. Refer to the Field Bus Discovery Service topic. |
| Connect[1] | This connects the DTM *(see page 46)* to its physical device on the network. This connection does not depend on the PLC online/offline status of the Unity Pro project application.<br>**NOTE:** Connecting a gateway or device DTM implicitly connects its parent DTM. |
| Disconnect[1] | This disconnects the DTM *(see page 46)* from its physical device. This disconnection depends on the PLC online/offline status of the Unity Pro project application.<br>**NOTE:** Disconnecting a gateway or device DTM implicitly disconnects its parent DTM. |
| Load data from device[1] | This loads data from the physical device on the network to the DTM. |
| Store data to device[1] | This loads data from the DTM to the physical device on the network. |
| Copy | This command is disabled. |
| Paste | This command is disabled. |
| Device menu | This command opens a sub-menu that contains device-specific commands, as determined by the device vendor.<br>For details, refer to the Communication Module Commands topic *(see page 44)*. |
| 1. This command also appears in the Unity Pro **Edit** menu.<br>2. This command also appears in the Unity Pro **View** menu. | |

| Name | Description |
|---|---|
| Device menu 2 | This command opens a sub-menu that contains device-specific commands, as determined by the device vendor.<br>For details, refer to the Communication Module Commands topic *(see page 44)*. |
| Properties[1] | Opens the Ethernet communication module **Properties** window. |
| Print device[1] | If this optional function is supported by a DTM, this function displays the device documentation — including configuration settings — in the PC's default Internet browser, which can then be printed.<br>**NOTE:** Device information can be printed:<br>● for only one device DTM at a time, when that DTM is not open for editing in the **Device Editor**.<br>● only when the DTM is disconnected from the physical device. |
| Zoom out[2] | This returns to the display of the entire DTM connectivity tree. |
| Expand all[2] | This displays DTMs below the selected DTM. |
| Collapse all[2] | This displays only the selected DTM. |
| 1. This command also appears in the Unity Pro **Edit** menu.<br>2. This command also appears in the Unity Pro **View** menu. | |

## Communication Module Commands

When you select **Device menu** in the main contextual menu for the communication module, a sub-menu with the following commands is displayed:

| Name | Description |
|---|---|
| Offline Parameter | This command is disabled. |
| Online Parameter | This command is disabled. |
| Compare | This compares 2 devices, either online or offline. |
| Configuration | This opens the **Device Editor** for the selected communication module, when the module and its DTM are disconnected. |
| Observe | This command is disabled. |
| Diagnosis | This opens the **Diagnosis Window** for the selected communication module, when the module and its DTM are connected. |

| Name | | Description |
|---|---|---|
| Additional functions | Add EDS to library | Opens the **EDS File Wizard**, which you can use to add a device EDS file to the Unity Pro EDS device library. Unity Pro displays the contents of EDS files as DTMs for use in the **DTM Browser** and **Device Editor**. |
| | Remove EDS from library | Opens the **EDS Deletion from Device Library** window, which you can use to delete an EDS file from the device library. |
| | Online Action | Opens the **Online Action** window. Depending upon the protocol(s) a remote device supports, you can use the **Online Action** window to:<br>● Ping a remote EtherNet/IP or Modbus TCP device<br>● view and write to EtherNet/IP properties in a remote EtherNet/IP device<br>● view and write to port configuration properties in a remote EtherNet/IP device |
| | EtherNet/IP Explicit Message | Opens the EtherNet/IP Explicit Message *(see page 300)* window, which you can use to send explicit messages to EtherNet/IP remote devices. |
| | Modbus TCP Explicit Message | Opens the Modbus TCP Explicit Message *(see page 302)* window, which you can use to send explicit messages to Modbus TCP remote devices. |
| | About | |
| | Advanced Mode | Displays or hides expert-level properties that help define Ethernet connections. See the Enabling Advanced Mode topic *(see page 47)* for instruction on how to use this feature. |

When you select **Device menu 2** in the main contextual menu for the communication module, a sub-menu with the following commands is displayed:

| Name | Description |
|---|---|
| Configuration | This opens the **Device Editor** for the selected communication module, when the module and its DTM are disconnected. |
| Diagnosis | This opens the **Diagnosis Window** for the selected communication module, when the module and its DTM are connected. |
| Add EDS to library | Opens the **EDS File Wizard**, which you can use to add a device EDS file to the Unity Pro EDS device library. Unity Pro displays the contents of EDS files as DTMs for use in the **DTM Browser** and **Device Editor**. |
| Remove EDS from library | Opens the **EDS Deletion from Device Library** window, which you can use to delete an EDS file from the device library. |

| Name | Description |
|---|---|
| Online Action | Opens the **Online Action** window. Depending upon the protocol(s) a remote device supports, you can use the **Online Action** window to:<br>● Ping a remote EtherNet/IP or Modbus TCP device<br>● view and write to EtherNet/IP properties in a remote EtherNet/IP device<br>● view and write to port configuration properties in a remote EtherNet/IP device |
| EtherNet/IP Explicit Message | Opens the EtherNet/IP Explicit Message *(see page 300)* window, which you can use to send explicit messages to EtherNet/IP remote devices. |
| Modbus TCP Explicit Message | Opens the Modbus TCP Explicit Message *(see page 302)* window, which you can use to send explicit messages to Modbus TCP remote devices. |
| Advanced Mode | Displays or hides expert-level properties that help define Ethernet connections. See the Enabling Advanced Mode topic *(see page 47)* for instruction on how to use this feature. |

## Connecting and Disconnecting a Device or Module DTM

A device or module DTM can be either connected to, or disconnected from, the physical device or module.

| When a device and its DTM are... | You can use the Ethernet configuration tool to... |
|---|---|
| Connected | Monitor and diagnose the real-time operation of the device or module |
| Disconnected | Configure a communication module or remote device by editing its properties |

**NOTE:** Distinguish between:

- connecting and disconnecting a DTM and the associated physical device using commands in the **DTM Browser**
  — and —
- placing Unity Pro in online or offline operating mode using commands in the Unity Pro **PLC** menu

You can connect a DTM to, or disconnect a DTM from a device or module using the contextual pop-up menu in the **DTM Browser**. The **DTM Browser** indicates the relationship between the DTM and the remote module or device: a connected DTM is displayed in **bold** text; a disconnected DTM is displayed in normal text.

To connect a DTM to, or disconnect a DTM from its respective module or device, follow these steps:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser** select the DTM that you want to connect to, or disconnect from, the physical communication module or remote device.<br>**NOTE:** If the module or device name appears in:<br>● **bold** text, it is connected and only the **Disconnect** command is enabled.<br>● normal text, it is disconnected and only the **Connect** command is enabled. |
| 2 | Click the right-mouse button.<br>**Result**: A pop-up menu opens. |
| 3 | Select one of the following commands:<br>● **Connect**<br>● **Disconnect**<br>**NOTE:** The **Connect** and **Disconnect** commands are also available in the Unity Pro **Edit** menu. |

## Enabling Advanced Mode

Use the contextual menu in the **DTM Browser** to toggle Unity Pro in or out of **Advanced Mode**, thereby displaying or hiding expert-level properties that help define Ethernet connections. These properties are identified by the icon.

**NOTE:** To maintain system performance, confirm that **Advanced Mode** properties are configured only by persons with a solid understanding of communication protocols.

To toggle **Advanced Mode** on and off:

| Step | Action |
|---|---|
| 1 | Close both the **Diagnosis Window** and every instance of the **Device Editor** before attempting to toggle **Advanced Mode** on or off.<br>**NOTE:** If the **Device Editor** or the **Diagnosis Window** is open, the **Advanced Mode** status — on or off — cannot be changed. |
| 2 | In the **DTM Browser**, right-click the communication module.<br>**Result**: A pop-up menu opens. |
| 3 | To toggle ON advanced mode, select **Device Menu** →**Advanced Mode**. |
| 4 | To toggle OFF advanced mode, repeat steps 1 through 3, above. |

# Field Bus Discovery Service

## Introduction

Use the field bus discovery service to detect and add to your Unity Pro application, network devices that are situated on a local network. The field bus discovery service is available only when the Ethernet communication module DTM is connected to its physical device.

Only the first level devices below the communication DTM are detected.

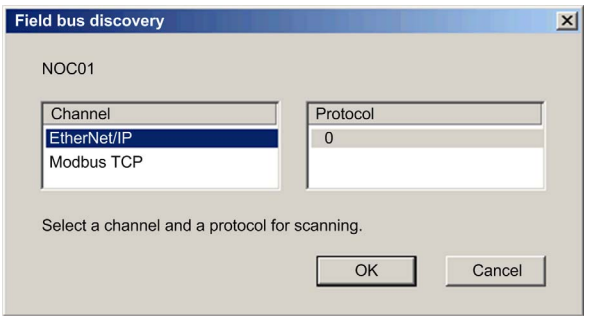
## Performing Field Bus Discovery

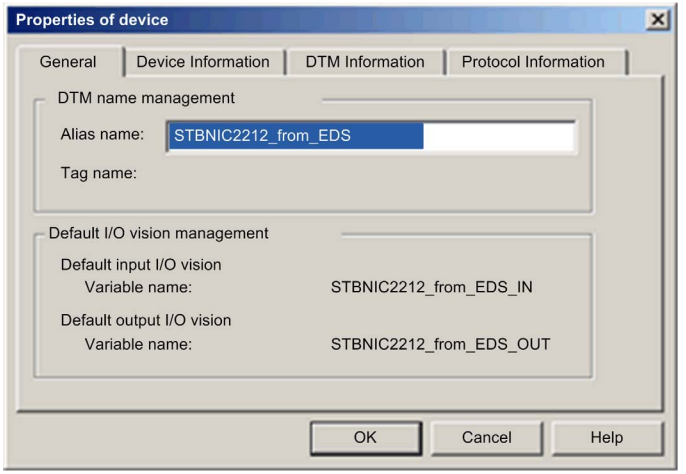
The results of the scanning process is compared to the registered DTMs in the DTM catalog of the computer. If a match is found in the DTM catalog for a scanned device, the results are accompanied with a matching type that gives the accuracy of the match.

These are the available matching types:

- *Exact match*: Every identification attribute matches. The correct device type was found.
- *Generic match*: At least the **Vendor** and device **Type ID** attributes match. The support level of the DTM is “Generic Support.”
- *Uncertain match*: At least the **Vendor** and device **Type ID** attributes match. The support level of the DTM is *not* “Generic Support.”

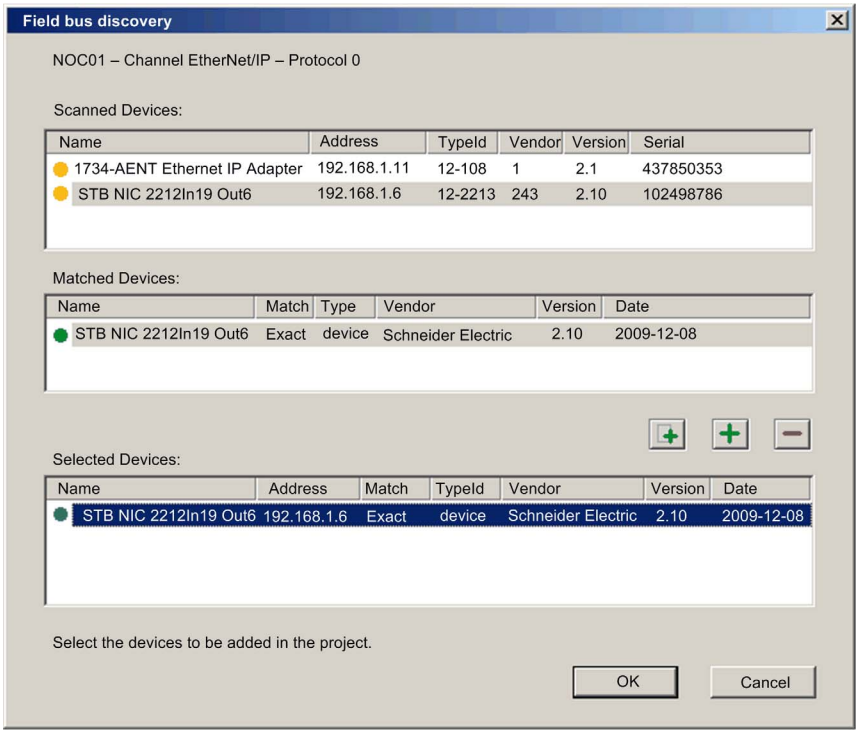
Use the field bus discovery service:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select an appropriate DTM.<br>**NOTE:** The field bus discovery service limits its search to the range of IP addresses that is pre-configured for the selected channel in the **Channel Properties** page *(see page 59)*. |
| 2 | Right-click the DTM and scroll to **Field bus discovery** to open the dialog box:<br>  |
| 3 | Under these conditions, select a channel and a protocol:<br>● The DTM has more than one channel.<br>● The channel supports more than one protocol. |
| 4 | Click on **OK**. The service starts to detect devices on the selected channel. |

| Step | Action |
|---|---|
| 5 | If at least one matched device has been found, the **Field Bus Discovery** dialog displays a list of **Scanned Devices**. |
| 6 | Use the controls of the **Field Bus Discovery** dialog to select the devices to add to your Unity Pro application. |
| 7 | After you have selected the devices you want to add in the **Field Bus Discovery** dialog, click **OK**. |
| 8 | If the field bus discovery process finds at least one device with an IP address that is already used in the project, you are asked if you want to continue and replace the existing project device(s):<br>● **Yes**: Proceed to the next step.<br>● **No**: Cancel automatic field bus discovery. |
| 9 | The device properties dialog (below) opens, displaying the default name for the first discovered device to be added:<br>  <br><br>In the **General** page of the device properties dialog, type in the **Alias name** for the device to be added, then click **OK**. The dialog closes, then re-opens if there is another device to be added to the application. |
| 10 | Repeat the above step for each additional discovered device. |
| 11 | After you finish adding devices to the application, configure each device for operation as part of the application:<br>● Disconnect the Ethernet communication module from its DTM. In the **DTM Browser**, select the Ethernet communication module, then select **Edit** →**Disconnect**.<br>● Configure the new device properties in the DTMs for both the Ethernet communication module, and the newly added remote device. |

## Field Bus Discovery Dialog

If at least one matched device has been found, the Field Bus Discovery dialog box is displayed listing the scanned and matched devices. Select the matched devices to be created in the Unity Pro project (which then shows up in the **Selected Devices** list:




This dialog presents these lists:

| List | Description |
|---|---|
| Scanned Devices | The devices (matched and unmatched) found during the scan. |
| Matched Devices | The matched DTMs found in the workstation DTM catalog for the device that you selected in the **Scanned Devices** list.<br>Each time a scanned device is selected in the **Scanned Devices** list, the contents of the **Matched Devices** list is updated to display the matched device DTMs found for the selected scanned device.<br>The matching process can yield one or more matched devices for a given scanned device. In this case, only one DTM was discovered for the selected scanned device. |
| Selected Devices | This list displays the device DTMs that have been selected in the **Matched Devices** list, which will be added to the Unity Pro project. |

The lists use the following colored icons:

| Color | Meaning |
|---|---|
| Green | The device has been selected. |
| Yellow | The device has been matched. |
| Red | The device has **not** been matched. |
| Black | Information about the address of the scanned device:<br>● In the **Scanned Devices** list, the device has an address identical to one of the DTMs in the Unity Pro project<br>● In the **Matched Devices** list, the device will be assigned an address identical to one of the DTMs in the Unity Pro project |
| **NOTE:** An icon can consist of two colors. For example, a search can discover a device that:<br>● has a matching DTM, and<br>● has an IP address identical to a device already added to the Unity Pro application<br>In this case, the icon next to the discovered device would be:<br>● half yellow and half black before it is selected, and<br>● half green and half black after it is selected | |

This dialog has five buttons:

| Button | Use this button to... |
|---|---|
| Add All | Automatically add the most closely matched (according to the matching types listed above) device DTM for each found device in the **Matched Devices** list to the **Selected Devices** list. |
| Add One | Add the matched device DTM selected in the **Matched Devices** list. |
| Remove | Remove one or more devices from the **Selected Devices** list. |
| OK | Insert the device DTMs in the **Selected Devices** list into the Unity Pro project.<br>If there are one or more devices in the **Selected Devices** list that have the same address in the Unity Pro project, a message box opens asking if you want to continue.<br>If you click **OK**, devices in the Unity Pro project that have identical addresses as the selected devices are **deleted** and **replaced** by the DTMs selected in the **Selected Devices** list. |
| Cancel | Cancel the field bus discovery scan and do nothing. Information in the three lists is discarded. |

# Device Editor

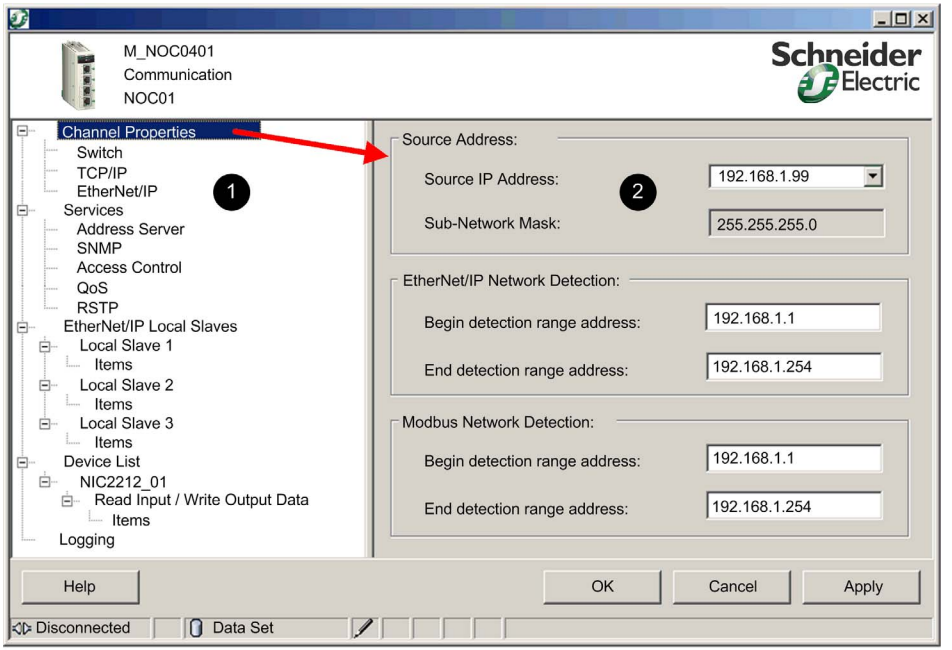
## Description

Use the **Device Editor** to view and configure Ethernet communication modules and remote devices. The collection of properties you can view or configure depends on:

- the node type selected in the **DTM Browser**:
  - communication module
  - remote device
- whether Unity Pro is operating in **Advanced Mode**

## Displaying Properties of the Ethernet Communication Module

After you open the BMX NOC 0401 Ethernet communication module in the **DTM Browser**, the left pane (1, below) of the **Device Editor** displays a tree control containing configurable property groups for the communication module. Click on a node in the tree control to display one or more pages of module properties for the selected group in the right pane (2, below).



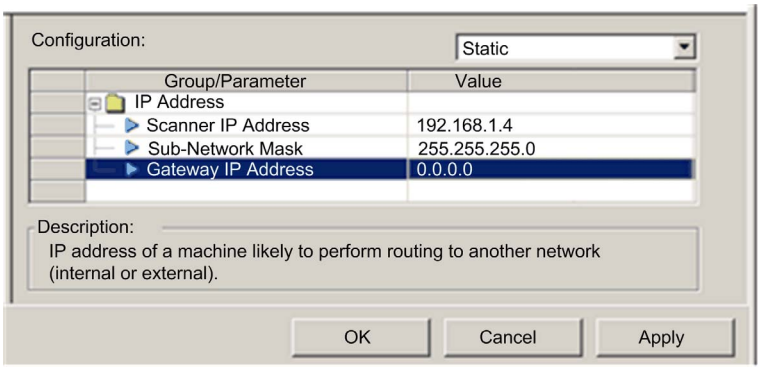
## Property Types

The **Device Editor** displays an icon next to many device properties. The following three icons are displayed:

| This icon... | Indicates the property is... |
|---|---|
| | Read-only. The property value cannot be edited in this page. |
| | Read-write. The property value can be edited in this page. |
| | An expert-level communication protocol property that is displayed only when **Advanced Mode** is enabled. |

## Displaying Property Definitions

Many property configuration pages provide an on-screen definition of the property you are editing. To display a property definition in the **Description** section of the page, select that property in the property list. The following screen displays a description of the **Gateway IP Address** property.




**NOTE:** The page displayed above can be accessed by opening an Ethernet communication module in the **Device Editor**, and then selecting **Channel Properties** →**TCP/IP** in the navigation tree.

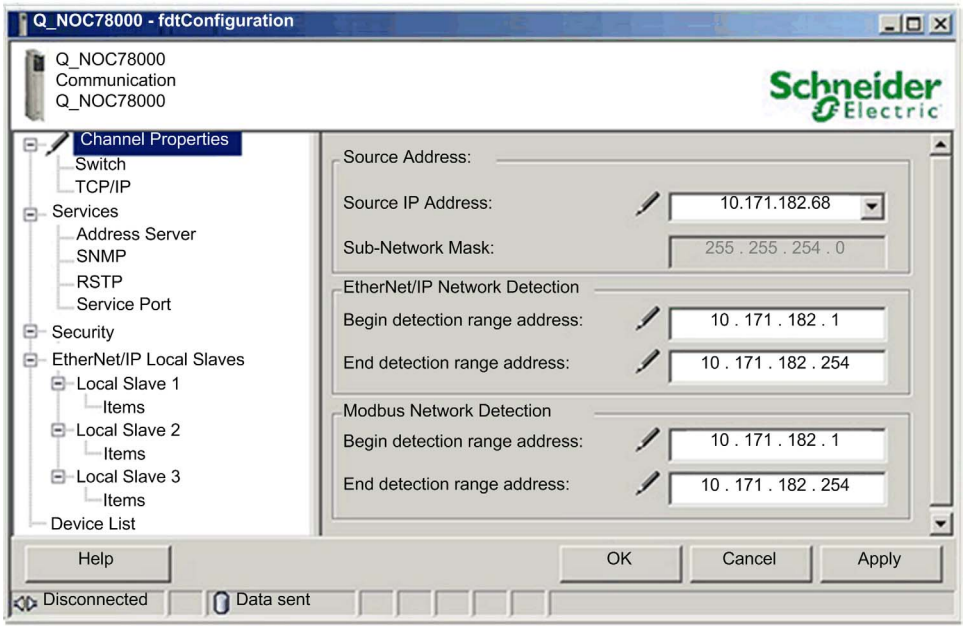
# Configuring Properties in the Device Editor

## Configuring Properties

The **Device Editor** can be opened from the **DTM Browser**.

To open the **DTM Browser** select **Tools** →**DTM Browser** in the Unity Pro main menu.

To use the **Device Editor**:

| Step | Description |
|---|---|
| 1 | Confirm that the DTM you want to use is not connected to the actual communication module or device. If necessary, disconnect the DTM from the module or device *(see page 46)*. |
| 2 | In the **DTM Browser**, select the Ethernet network node you want to configure, which can be either:<br>● an Ethernet communication module<br>— or —<br>● a remote device |
| 3 | With a node selected in the **DTM Browser**, do one of the following:<br>● In the Unity Pro main menu, select **Edit** →**Open**.<br>— or —<br>● In the **DTM Browser** click the right mouse button and, in the pop-up menu, select **Open**.<br>The **Device Editor** appears. It displays the configurable properties for the selected module or device:<br>  |

<table>
<tr><th>Step</th><th colspan="2">Description</th></tr>
<tr><td>4</td><td colspan="2">Expand the navigation tree and select a node in the left window pane to display its properties in the right pane. The list of configurable properties varies, depending on the node type — communication module or remote device — selected in the DTM Browser.</td></tr>
<tr><td rowspan="4">5</td><td colspan="2">While you edit a parameter, Unity Pro displays an icon — next to the field you are editing and in the navigation tree — indicating the parameter value is being edited. Unity Pro displays one of the following icons:</td></tr>
<tr><td>This icon...</td><td>Indicates the importance of the parameter being edited is...</td></tr>
<tr><td></td><td>High: Editing this parameter may limit or deny access to the module or device.</td></tr>
<tr><td> </td><td>Low: Editing this parameter will not limit or deny access to the module or device.</td></tr>
<tr><td>6</td><td colspan="2">After you finish editing a page, click:<br>● Apply to save your edits and keep the page open.<br>— or —<br>● OK to save your edits and close the page.<br>NOTE: Your edits will not take effect until they are successfully downloaded from your PC to the CPU and from the CPU to the communication modules and network devices.</td></tr>
</table>

# Uploading and Downloading DTM-Based Applications

## Introduction

You can use Unity Pro to download an application file from your PC to the PLC, and to upload an application file from the PLC to your PC.

To perform a successful upload, confirm that the application file includes specific upload-related information as part of the application.

## Downloading DTM-Based Applications

Unity Pro applications that include DTM files require more memory than traditional Unity Pro applications. The following products employ DTMs for network configuration:

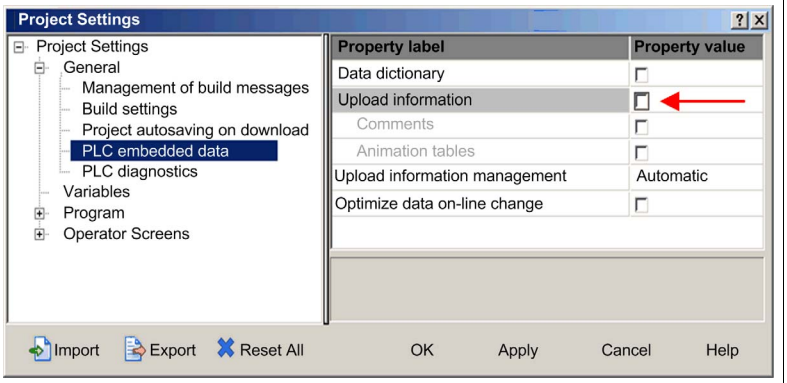
- 140 NOC 771 01 Ethernet Communication Module for Quantum
- TSX ETC 101 Ethernet Communication Module for Premium
- BMX NOC 0401 Ethernet Communication Module for M340

In some cases, the configurations created for these modules—and the data associated with them—will require more memory than is available in the CPU.

If the amount of memory required by an application exceeds the amount of memory that is available in the CPU, Unity Pro displays a message during the build process, before the application is downloaded to the PLC.

When this situation occurs, exclude the additional upload-related information from the application to complete the build and enable the application download. To do this, make the following configuration change in Unity Pro:

| Step | Action |
|---|---|
| 1 | In the main menu, select **Tools** →**Project Settings...** The Project Settings window opens. |
| 2 | In the left pane of the Project Settings window, select **General** → **PLC embedded data**. |

| Step | Action |
|---|---|
| 3 | In the right pane, de-select **Upload information**:<br>  |
| 4 | Click **OK** to save your changes and close the Project Settings window. |

After the **Upload information** setting is disabled, you can build the application and download it to the PLC.

**NOTE:** An application in which the **Upload information** setting has been disabled cannot later be uploaded from the PLC to the PC.

## Uploading DTM-Based Applications

DTM-based applications that were successfully downloaded to Unity Pro—with the project's **Upload information** setting enabled—can later be uploaded from the PLC to the PC if the target PC has the following files installed on it:

- a version of Unity Pro that is equal to or higher than the version used to create the application
- the master DTMs for the modules included in the configuration
  **NOTE:** The Ethernet Configuration Tool installation CD contains the Master DTMs for the Ethernet communication modules, referenced above.
- the device DTMs for the DTM-based devices attached to the network (confirm that the DTMs are of the same or higher revision as each device DTM used in the configuration)
- the device EDS files for any EtherNet/IP device used in the configuration (confirm that the EDS files are of the same or higher revision as each device EDS file used in the configuration)

After the above components have been installed on the target PC, you can upload a DTM-based Unity Pro application from a PLC.

**NOTE:** Confirm that each of the above DTM components is installed on the target PC *before* attempting the upload.

# Section 2.4
# Channel Properties

## Overview

This section describes how to configure channel properties for the Ethernet network.

## What Is in This Section?

This section contains the following topics:


| Topic | Page |
|---|---|
| Channel Properties Page | 59 |
| Channel Properties - Switch Settings | 61 |
| Channel Properties - QoS Queue | 62 |
| Channel Properties — TCP/IP Page | 65 |
| Channel Properties - EtherNet/IP Page | 70 |

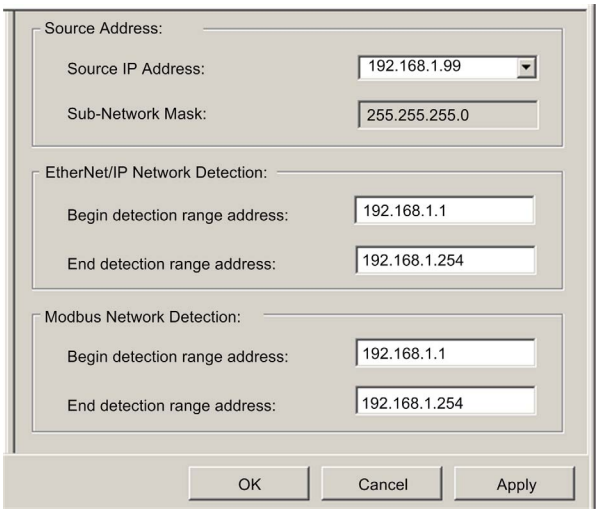
# Channel Properties Page

## Description

Use the **Channel Properties** page to:

- select the IP address to use for:
  - connecting module or device DTMs to physical devices, and
  - sending explicit messages to Modbus TCP and EtherNet/IP devices
- view your PC's IP address settings

The **Channel Properties** page looks like this:




To display this page, select the **Channel Properties** node in the navigation tree located on the left side of the **Device Editor**.

**NOTE:** Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to edit properties.

## Properties

This page presents the following properties:

| Name | Description |
|---|---|
| Source Address area: | |
| Source IP Address: | A list of IP addresses assigned to network interface cards installed on your PC. |
| Sub-Network Mask: | The subnet mask associated with the selected Source IP Address. |
| EtherNet/IP Network Detection area: | |
| Begin detection range address | The starting IP address of the address range for automatic field bus discovery of EtherNet/IP devices. |
| End detection range address | The ending IP address of the address range for automatic field bus discovery of EtherNet/IP devices. |
| Modbus TCP Network Detection area: | |
| Begin detection range address | The starting IP address of the address range for automatic field bus discovery of Modbus TCP devices. |
| End detection range address | The ending IP address of the address range for automatic field bus discovery of Modbus TCP devices. |

# Channel Properties - Switch Settings

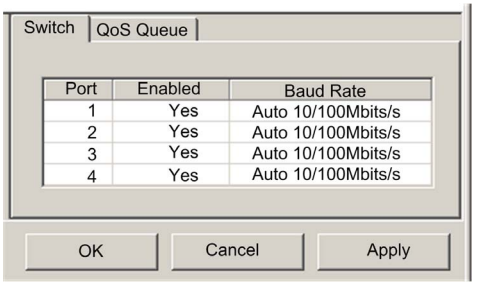
## Description

Use the **Switch** tab of the **Switch** page to:

- enable or disable each of the four Ethernet ports on the BMX NOC 0401 communication module
- view and edit the **Baud Rate** for each port, which includes both the:
  - transmission speed, and
  - duplex mode

**NOTE:** The Ethernet communication module supports only the **Ethernet II** frame type.

The **Switch** page looks like this:




To display this page, select the **Channel Properties** →**Switch** node in the navigation tree located on the left side of the **Device Editor**, then click on the **Switch** tab.

**NOTE:** Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to edit properties.

## Properties

This page presents the following properties:

| Name | Description |
|---|---|
| Port | (read-only) The Ethernet port number: 1...4. |
| Enabled | The active status of the port:<br>● Yes = enabled<br>● No = disabled |
| Baud Rate | The transmission speed and duplex mode for the network. Values include:<br>● Auto 10/100 Mb (default)<br>● 100 Mb Half<br>● 100 Mb Full<br>● 10 Mb Half<br>● 10 Mb Full<br>**NOTE:** Schneider Electric recommends the default setting—Auto 10/100 Mb. This setting causes the connected devices to perform auto-negotiation and thereby determine the fastest common transmission rate and duplex mode. |

# Channel Properties - QoS Queue

## Description

The BMX NOC 0401 Ethernet communication module can be configured to sort packets it receives by placing them into one of 4 separate queues—based upon their priority (very high, high, low, very low)—and handle each packet in the order of its priority.

The module also can be configured to add a *differentiated service code point* (DSCP) value to each packet it originates, indicating the relative priority of the packet.

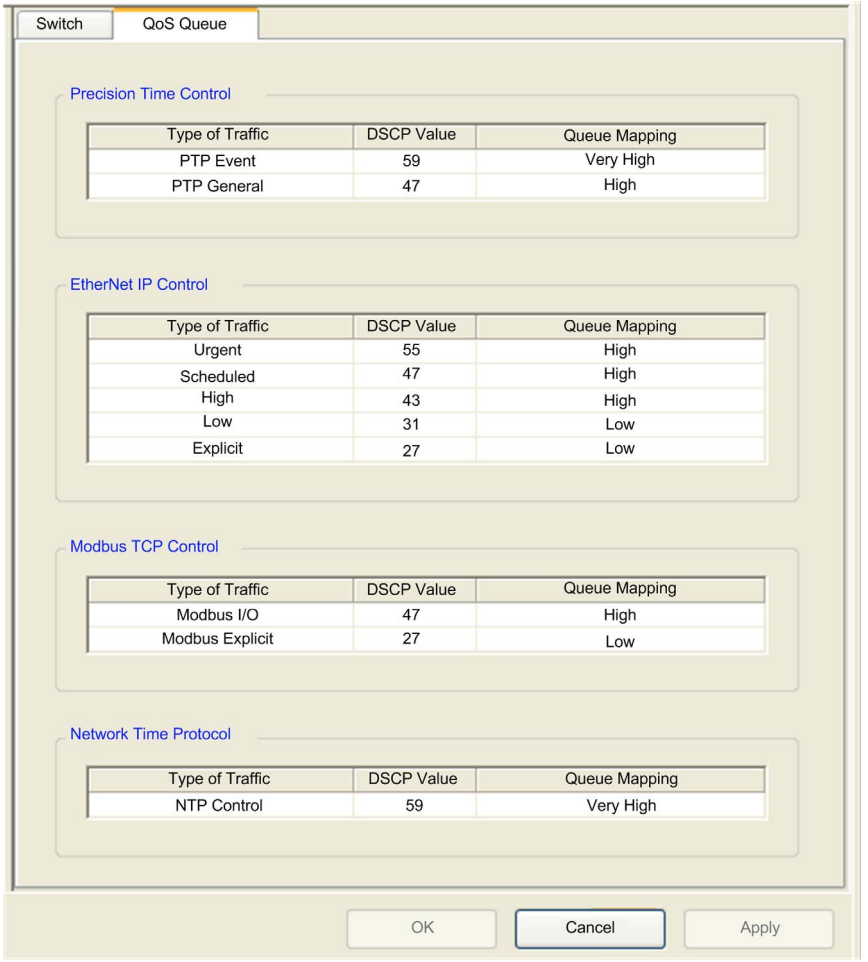
The process of packet queuing and DSCP tagging together enable the module to perform Ethernet packet traffic management.

Use the **QoS Queue** tab of the **Channel Properties** →**Switch** page to assign *differentiated service code point* (DSCP) values and queueing priorities to Ethernet packets based on their message type.

**NOTE:**

- The settings input in this page are synchronized with the values input in the **Services** →**QoS** page *(see page 86)*. Edits to a common property in either page will change that value in the other page.
- The **Explicit Message** group settings are editable only when Unity Pro is operating in **Advanced Mode**.
- Confirm that every switch in your network adopts the same DSCP tagging scheme, thereby providing consistent packet traffic management throughout your network.

The **QoS Queue** page, displaying the default settings, looks like this:


Switch
QoS Queue
Precision Time Control
Type of Traffic | DSCP Value | Queue Mapping
PTP Event | 59 | Very High
PTP General | 47 | High
EtherNet IP Control
Type of Traffic | DSCP Value | Queue Mapping
Urgent | 55 | High
Scheduled | 47 | High
High | 43 | High
Low | 31 | Low
Explicit | 27 | Low
Modbus TCP Control
Type of Traffic | DSCP Value | Queue Mapping
Modbus I/O | 47 | High
Modbus Explicit | 27 | Low
Network Time Protocol
Type of Traffic | DSCP Value | Queue Mapping
NTP Control | 59 | Very High
OK
Cancel
Apply

To display this page, select the **Channel Properties** →**Switch** node in the navigation tree located on the left side of the **Device Editor**, then click on the **QoS Queue** tab.

**NOTE:** Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to edit properties.

## QoS Queue Mapping Settings

DSCP settings have a range of 0...63. The range of **Queue Mapping** settings are set forth below:

| Group | Traffic Type | Available Group Queue Settings |
|---|---|---|
| Precision Time Control | Point-to-point event | • Very High<br>• High |
| | Point-to-point general | • High<br>• Low<br>• Very Low |
| IEtherNet IP Control[1] | Urgent | • High<br>• Low<br>• Very Low |
| | Scheduled | |
| | High | |
| | Low | |
| | Explicit[2] | |
| Modbus TCP Control[1] | Modbus I/O | • High<br>• Low<br>• Very Low |
| | Modbus Explicit | |
| Network Time Protocol | NTP Control | • Very High<br>• High<br>• Low<br>• Very Low |

1. Edits to these properties are synchronized with the **Services** →**QoS** page *(see page 86)*.
2. Editable only in **Advanced Mode**.

# Channel Properties — TCP/IP Page

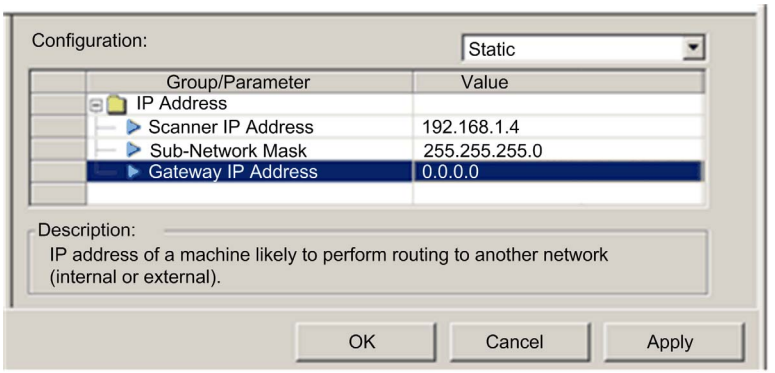
## Description

Use the **TCP/IP** page to:

- select a **Configuration** mode, which specifies how the communication module obtains its IP addressing settings, and
- edit the IP addressing settings that will be used if the **Configuration** mode is set to **Static**

**NOTE:** The settings made in this page can either match or conflict with the manual settings made using the 2 rotary switches on the back of the module. See the Resolving Conflicting Hardware and Software IP Address Settings topic for an explanation of when IP addressing conflicts exist and how the module resolves them.

The **TCP/IP** page looks like this:




To display this page, select the **Channel Properties** →**TCP/IP** node in the navigation tree located on the left side of the **Device Editor**.

**NOTE:** Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to edit properties.

## Properties

The IP addressing properties you can configure in this page depends upon the selected configuration mode:

| Property | Description | Configuration Mode Options |
|---|---|---|
| Scanner IP Address | The 32-bit identifier — consisting of both a network address and a host address — assigned to a device connected to a TCP/IP Internet network using the Internet Protocol (IP). | • Static<br>• Flash memory<br>• BOOTP<br>• DHCP |
| Sub-Network Mask | The 32-bit value used to hide (or mask) the network portion of the IP address and thereby reveal the host address of a device on a network using the IP protocol. | • Static |

| Property | Description | Configuration Mode Options |
|---|---|---|
| Gateway Address | The address of a device, if any, that serves as a gateway to the communication module. | • Static |
| Name | The device name.<br>**NOTE:** The default device name, based on the rotary switch settings is BMX_0401_xxy. where:<br>• xx is the value of the upper switch setting (tens)<br>• y is the value of the lower switch setting (ones) | • DHCP |

## Selecting a Configuration Mode

Use the **Configuration** list to specify a configuration mode. The configuration mode setting determines how the communication module obtains its IP address at startup. Choices are:

| Configuration Mode | Description |
|---|---|
| Static | The module uses the scanner IP address, gateway IP address, and sub-network mask configured in this page. |
| Flash Memory | The module uses the IP address configured via the TCP/IP object and stored flash memory. An IP address configured by this process survives both a warm and a cold re-start. |
| BOOTP | The module uses an IP address assigned by a BOOTP server. |
| DHCP[1] | The module uses an IP address assigned by a DHCP server. |

## Default Address Configurations

The communication module uses a default address configuration when it is not configured or when a duplicate IP address is detected. The default address is based on the MAC address of the module and makes it possible for several Schneider Electric devices to use their default network configuration on the same network.

The module uses the following default address configurations:

- Default IP Address
  This default address starts with 10.10 and uses the last two bytes of the MAC address. As an example, a device with the MAC address of 00:00:54:10:8A:05 has a default IP address of 10.10.138.5 (0x8A=138, 0x05=5).
- Default Sub-Network Mask
  The default address is 255.0.0.0 (a class A mask).
- Default Gateway Address
  The default gateway address is identical to the default IP address.

## Duplicate Address Checking

Before going online, the module sends out at least 4 ARP (address resolution protocol) messages with a proposed IP address:

- if an answer is returned:
  - another network device is already using the proposed IP address
  - the module will not use the proposed IP address, but will instead use the default IP address
- if an answer is not returned:
  - the module is assigned the proposed IP address (along with the associated network parameters.)

**NOTE:** When powering up an entire network, some switches may be slow to complete the power up process. This can cause some ARP messages to be dropped. To help avoid this situation, Schneider Electric recommends that, when powering up an entire network, confirm that every network switch completes its power up cycle before powering up the PLCs.

## Resolving Conflicting Hardware and Software IP Address Settings

The following table summarizes the status of the Ethernet channel depending on the **Configuration Mode** set in the application, and the positions of the 2 rotary switches on the back of the module:

| **Application: Configuration Mode** | **Rotary Switch Position** | | | |
|---|---|---|---|---|
| | **DHCP**[1] | **BOOTP** | **STORED** | **CLEAR IP** |
| <no configuration> | **No Conflict:** Get IP address from DHCP server using device name from rotary switches.<br>Start basic services only. | **No Conflict:** Get IP address from BOOTP server.<br>Start basic services only. | **No Conflict:** Get IP address from:<br>● flash memory<br>— or —<br>● BOOTP server<br>— or —<br>● use default IP address<br>Start basic services only. | **No Conflict:** Use default IP address.<br>Start basic services only. |
| Static or Flash memory | **Conflict:** Get IP address from DHCP server using device name from rotary switches.<br>Start basic services only. | **Conflict:** Get IP address from BOOTP server.<br>Start basic services only. | **No Conflict:** Get IP address from the application.<br>Start services configured in the application. | |
| DHCP or BOOTP with no configured device name | **No Conflict:** Get IP address from DHCP server using device name from rotary switches.<br>Start services configured in the application. | **No Conflict:** Get IP address from BOOTP server.<br>Start services configured in the application. | **No Conflict:** Get IP address from BOOTP server.<br>Start services configured in the application. | |
| DHCP with a configured device name | **Conflict** (if device name on switches differs from name in application) or **No Conflict:** if names are equal.<br>Get IP address from DHCP server using device name from rotary switches.<br>If conflict, start basic services only; If no conflict, start services configured in the application. | **Conflict:** Get IP address from BOOTP server.<br>Start basic services only. | **No Conflict:** Get IP address from DHCP server using device name from application.<br>Start services configured in the application. | |

1. Based on device name BMX_0401_xxy, where x = the top rotary switch, and y represents the bottom rotary switch.

## Basic Services

The following services are provided by the module when it is using its default IP address:

- FTP server (used for firmware download)
- HTTP/Web server
- Modbus/TCP server
- EtherNet/IP explicit message server
- SNMP agent
- RSTP

**NOTE:** Using the module as a messaging server, when the module is using its default IP address, is not recommended. The module will replace the default IP address with a served or user-configured IP address as soon as one is received.

# Channel Properties - EtherNet/IP Page

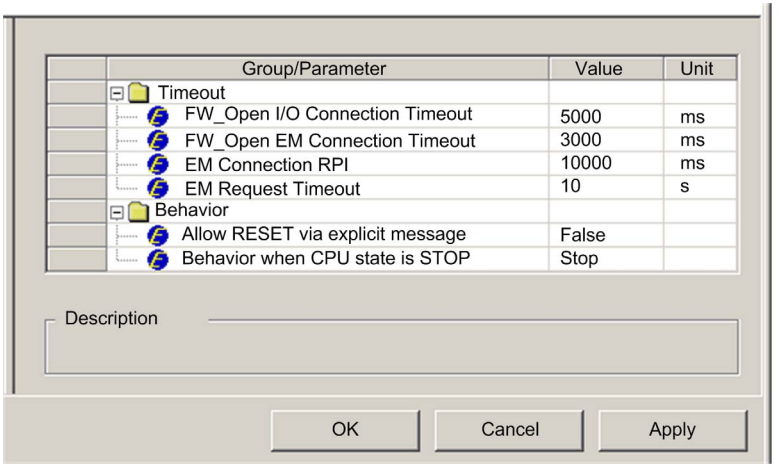
## Description

The **EtherNet/IP** page is displayed only when Unity Pro is operating in Advanced Mode *(see page 47)*. Advanced mode properties are identified by the icon.

Use the **EtherNet/IP** page to configure the following communication module properties:

- properties that determine how the communication module, as a scanner, opens connections for both implicit and explicit messages
- the frequency for transmitting produced data over implicit messaging connections
- the timeout period for explicit messaging connections
- the behavior of the communication module—as a scanner—when:
  - the application is stopped, or
  - the communication module receives a reset service request

The **EtherNet/IP** page looks like this:




To display this page, select the **Channel Properties** →**EtherNet/IP** node in the navigation tree located on the left side of the **Device Editor**.

**NOTE:** Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to edit properties.

## Properties

**Note:** Users experienced in the configuration of EtherNet/IP networks can edit the following read-write properties.

| Name | Description |
|---|---|
| **Timeout** | |
| FW_Open IO Connection Timing | The amount of time the communication module waits for the Forward_Open IO messaging transaction to open an implicit messaging connection.<br>Default = 5000 ms |
| FW_Open EM Connection Timing | The amount of time the communication module waits for the Forward_Open IO messaging transaction to open an explicit messaging connection.<br>Default = 3000 ms |
| EM Connected RPI | The value used to set the T->O (target to originator) and O->T (originator to target) requested packet interval (RPI) for explicit message connections. This value is used to calculate the lifetime of a connection.<br>Default = 10000 ms. |
| EM Request Timeout | The amount of time the communication module waits between a request and reply of an explicit message.<br>Default =10 s. |
| **Output** | |
| Allow reset explicit message | The behavior of the communication module—as scanner—when it receives a reset service request:<br>● TRUE indicates the module will accept the request and reset itself.<br>● FALSE indicates the module ignores the reset service request and continues uninterrupted operations.<br>Default = FALSE |
| Behavior when CPU state is STOP | The state of the communication module when the CPU application goes into a STOP state:<br>● TRUE indicates that the module enters STOP state (implicit connections are closed).<br>● FALSE indicates that the module enters IDLE state (implicit connections are not closed).<br>Default = FALSE |

# Section 2.5
# Ethernet Services

## Overview

This section describes how to enable and configure Ethernet services provided by the BMX NOC 0401 communication module.

## What Is in This Section?

This section contains the following topics:


| Topic | Page |
|---|---|
| Enabling Ethernet Services | 73 |
| Configuring the DHCP and FDR Servers | 75 |
| Configuring the SNMP Agent | 81 |
| Configuring Access Control | 84 |
| Configuring QoS Ethernet Packet Tagging | 86 |
| Configuring the Rapid Spanning Tree Protocol | 89 |
| Configuring the Email Service | 92 |
| Sending Email via the SEND_EMAIL Block | 95 |
| Configuring the Network Time Service | 97 |

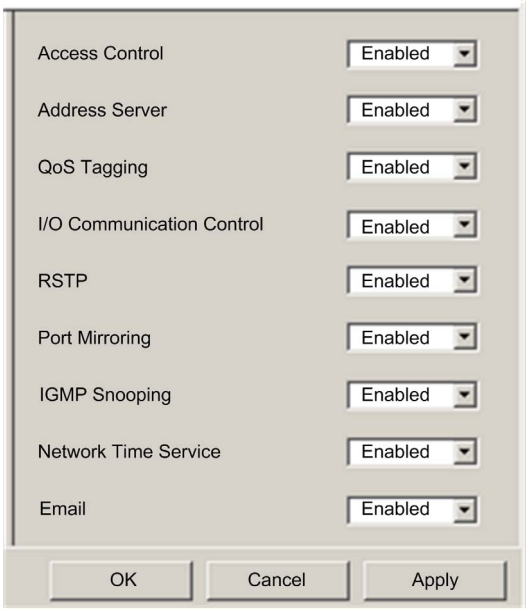
# Enabling Ethernet Services

## Service List

Use the **Services** page to enable and disable Ethernet services provided by the communications module.

**NOTE:** After you enable any service, you can configure its settings. Unity Pro applies default settings to services you enable but elect not to configure.

The **Services** page looks like this:




To display this page, select the **Services** node in the navigation tree located on the left side of the **Device Editor**.

After you **Enable** a service in this page, the next step is to configure that service. Depending upon the specific service, it can be configured in either the Unity Pro **Device Editor** (by selecting a node beneath the **Services** parent node) or in the module's web pages.

**NOTE:** Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to edit properties in Unity Pro.

## Service Descriptions

The Ethernet communication module can be configured to provide the following services:

| This service... | Enables the module to... | Configurable in... |
|---|---|---|
| SNMP | • serve as an SNMP v1 agent<br>• provide trap information to up to two devices configured as SNMP managers.<br>**NOTE:** The SNMP service is enabled by default and cannot be disabled. | (not editable) |
| Access Control | deny access to the Ethernet communication module from unauthorized devices. | Device Editor |
| Address Server | provide both IP addressing parameters and operating parameters to other Ethernet devices. | Device Editor |
| QoS Tagging | add *Differentiated Services Code Point* (DSCP) tags to Ethernet packets so that network switches can prioritize the transmission and forwarding of Ethernet packets.<br>**NOTE:** Before enabling QoS tagging, confirm that devices connected to the Ethernet communication module support QoS tagging. | Device Editor |
| I/O Communication Control | allow the Unity Pro application to control the enabling and disabling of individual connections between the communication module and remote I/O devices.<br>**NOTE:**<br>• The application can open and close individual connections using the control bits located at the beginning of the output area.<br>• If this service is disabled the user—via the application program—cannot toggle on and off connection control bits | Device Editor |
| RSTP | employ the *rapid spanning tree protocol* (RSTP)—in combination with other similarly-configured network devices—to manage redundant physical connections and create a loop-free logical path connecting the network devices. | Device Editor |
| Port Mirroring | duplicate the traffic entering and exiting any one of the four Ethernet ports onto another non-RSTP destination port, for the purpose of diagnosing the source port. | Web pages |
| IGMP Snooping | restrict outbound multicast transmissions to only those ports with downstream consumers. | <no configuration required> |
| Network Time Service | provide the source time synchronization signal for the PLC controller, which manages an internal clock to maintain this time. | Device Editor |
| Email | enable the sending—but not receiving—of email messages from the PLC application to a standard SMTP server. | Device Editor |

# Configuring the DHCP and FDR Servers

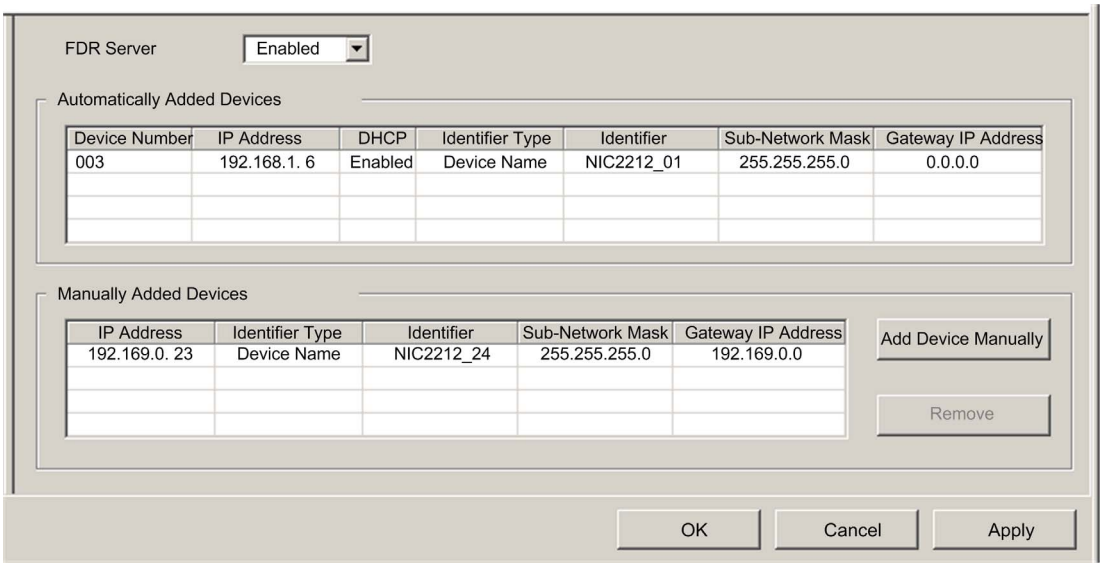
## Description

The Ethernet communication module includes both a DHCP and a Faulty Device Replacement (FDR) server. The DHCP server provides IP address settings to networked Ethernet devices. The FDR server provides operating parameter settings to replacement Ethernet devices that are equipped with FDR client functionality.

Use the **Address Server** page to:

- enable and disable the communication module's FDR service
- view an automatically generated list of devices included in the communication module's Ethernet configuration, displaying for each device:
  - IP addressing parameters, and
  - whether the device's IP addressing parameters are provided by the communication module's embedded DHCP server
- manually add remote devices—that are not part of the communication module's Ethernet configuration—to the communication module's DHCP client list
  **NOTE:** Confirm that each device you manually add is equipped with DHCP client software, and is configured to subscribe to the communication module's IP addressing service.

The **Address Server** page looks like this:



To display this page:

| Step | Description |
|---|---|
| 1 | Select the **Services** node in the navigation tree located on the left side of the **Device Editor**. The **Services** page opens. |
| 2 | In the **Services** page, set the **Address Server** field to **Enabled**. The **Address Server** node appears in the navigation tree. |
| 3 | Select the **Address Server** node in the navigation tree. |

## Enabling the FDR Service

To enable the communication module's FDR service, set the **FDR Server** field to **Enabled**. To disable the service, toggle the same field to **Disabled**.

**NOTE:** Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to apply edited properties to networked devices.

Any networked Ethernet device equipped with FDR client functionality can subscribe to the communication module's FDR service. The communication module can store up to 1 MB of FDR client operating parameter files. When this file storage capacity is reached, the module can not store any additional client FDR files.

The communication module can store FDR client files for up to 128 devices, depending on the size of each stored file. For example, if the size of each FDR client file is small—not more than 8 Kb—the module could store up to the maximum of 128 parameter files.

## Manually Adding Remote Devices to the DHCP Service

Remote devices that are part of the communication module's Ethernet configuration—and which have subscribed to the communication module's IP addressing service—automatically appear in the **Automatically Added Devices** list.

Other remote devices—that are not part of the communication module's configuration—can be manually added to the communication module's DHCP IP addressing service.

To manually add networked Ethernet devices, which are not part of the communication module's Ethernet configuration, to the communication module's IP addressing service:

| Step | Description | |
|---|---|---|
| 1 | In the **Address Server** page, click the **Add Device Manually** button. Unity Pro adds an empty row to the list of **Manually Added Devices**. | |
| 2 | In the new row, configure the following parameters for the client device: | |
| | IP Address | Type in the IP address of the client device. |
| | Identifier Type | Select the type of value the client device will use to identify itself to the FDR server:<br>● MAC address<br>● Device Name |
| | Identifier | Depending upon the identifier type, type in the client device setting for the MAC address or Name. |
| | Mask | Type in the client device subnet mask. |
| | Gateway | Type in the gateway address that remote devices can use to communicate with devices located on other networks. Use 0.0.0.0 if remote devices will not communicate with devices located on other networks. |
| 3 | Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to apply edited properties to networked devices. | |

## Viewing the Auto-Generated DHCP Client List

The list of **Automatically Added Devices** includes a row for each remote device that is:

- part of the communication module's Ethernet configuration, and
- configured to subscribe to the communication module's DHCP addressing service

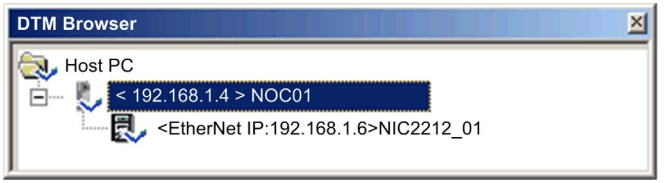
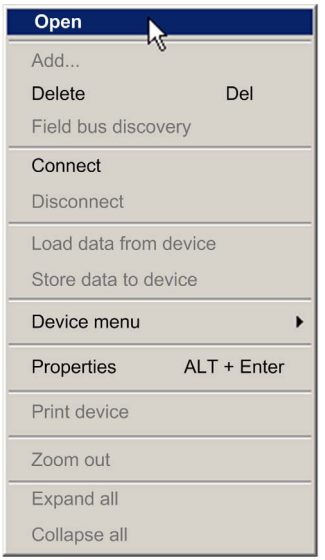
**NOTE:** You cannot add devices to this list in this page. Instead, use the configuration pages for the remote device to subscribe to this service.

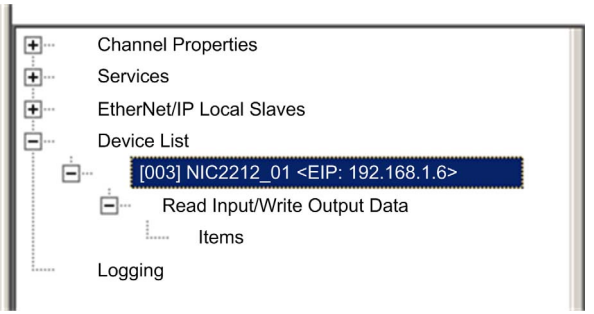
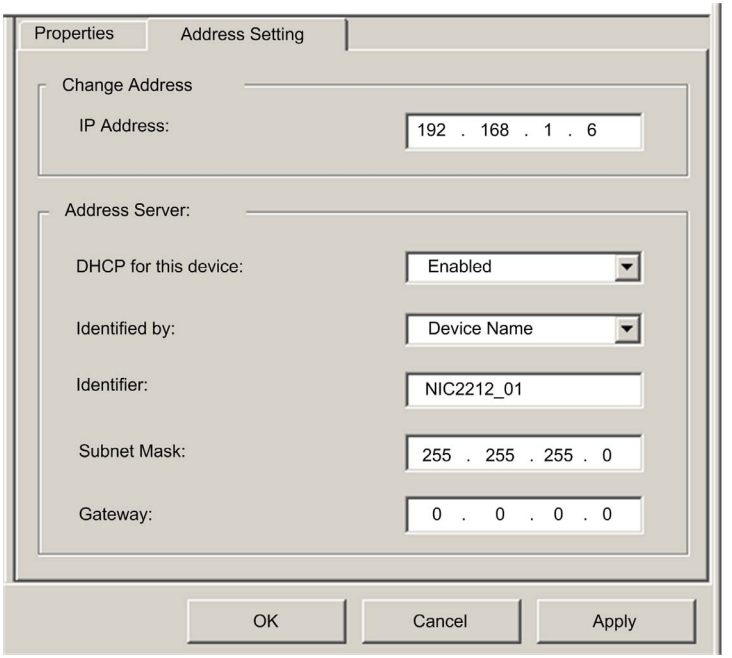
The list of **Automatically Added Devices** contains the following information for each networked device:

| Property | Description |
|---|---|
| Device Number | The number assigned to the device in the Unity Pro configuration. |
| IP Address | The client device IP address. |
| Enable DHCP | TRUE indicates that the device subscribes to the DHCP service. |
| Identifier Type | Indicates the mechanism used by the server to recognize the client (MAC address or DHCP device name). |
| Identifier | The actual MAC address or DHCP device name. |
| Mask | The client device subnet mask. |
| Gateway | The IP address a DHCP client device will use to access other devices that are not located on the local subnet. A value of 0.0.0.0 constrains the DHCP client device by allowing it to communicate only with devices on the local subnet. |

## Subscribing to the DHCP Service for a Device that is Part of the Configuration

An Ethernet device—that is part of the communication module Ethernet configuration—can subscribe to the communication module's IP addressing service. To subscribe to this service, follow these steps:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select the Ethernet communication module that is connected to the remote device that you want to add to the DHCP service. In the following example, the communication module with the alias name of **NOC01** is selected:<br>  <br><br>**NOTE:** The selected module is connected to the STB NIC 2212 network interface device bearing the alias name **NIC2212_01**, which is the module you want to add to the DHCP service. |
| 2 | With **NOC01** selected in the **DTM Browser**, click the right mouse button, and select **Open** in the pop-up menu.:<br>  <br><br>The **Device Editor** opens. |

| Step | Action |
|---|---|
| 3 | In the navigation tree on the left side of the **Device Editor**, expand the **Device List** node and select the device for which you want to enable the DHCP service. In this example, select **NIC2212_01**:<br>  <br><br>Unity Pro displays the properties for the selected remote device in the right pane of the window. |
| 4 | In the right pane of the window, select the **Address Setting** tab to display the following page:<br>  <br> |

| Step | Action | |
|---|---|---|
| 5 | In the **Address Server** area of this page, configure the following properties: | |
| | **DHCP for this device** | Select **Enabled** |
| | **Identified by** | The choices are:<br>● **MAC Address**, or<br>● **Device Name**<br>Select **Device Name**. |
| | **Identifier** | Unity Pro has automatically added the device name **NIC2212_01**. For the purpose of this example, accept this default value. |
| | **Subnet Mask** | Unity Pro has automatically applied the same subnet mask used for the Ethernet communication module. For the purpose of this example, accept the default value of **255.255.255.0**. |
| | **Gateway** | For the purpose of this example, accept the default value of **0.0.0.0**. |
| 6 | Click **OK** to save your edits.<br>**NOTE:** Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for more information on editing and saving property settings in this window. | |

# Configuring the SNMP Agent

## Description

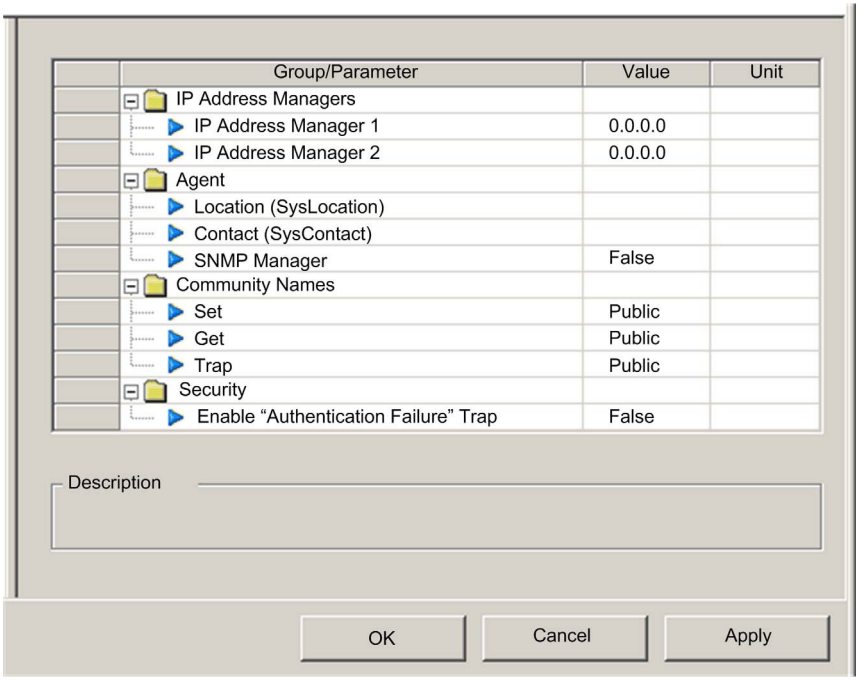
The Ethernet communication module includes an SNMP v1 agent. An SNMP agent is a software component running on the communication module that allows access to the module's diagnostic and management information via the SNMP service.

SNMP browsers, network management software, and other tools typically use SNMP to access this data. In addition, the SNMP agent can be configured with the IP address of up to two devices—typically PC's running network management software—to be the target of event driven trap messages. These trap messages inform the management device of events such as cold start, and detected authentication failures.

Use the **SNMP** page to configure the SNMP agent in the communication module. The SNMP agent can connect to and communicate with up to 2 SNMP managers as part of an SNMP service. The SNMP service includes:

- authentication checking, by the Ethernet communication module, of any SNMP manager that sends SNMP requests
- management of event, or trap, reporting by the module

The **SNMP** page looks like this:



To display this page:

| Step | Description |
|---|---|
| 1 | Select the **Services** node in the navigation tree located on the left side of the **Device Editor**. The **Services** page opens. |
| 2 | In the **Services** page, set the **SNMP** field to **Enabled**, then click **OK** or **Apply**. The **SNMP** node appears in the navigation tree. |
| 3 | Select the **SNMP** node in the navigation tree. |

**NOTE:** Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to edit properties.

## Viewing and Configuring SNMP Properties

**NOTE:** The sysName SNMP parameter is neither editable nor visible in the Unity Pro Ethernet Configuration Tool software. By default, the sysName is set to the Ethernet communication module part number.

**NOTE:** When DHCP is enabled and **Device Name** is selected as the DHCP identifier for the module, the SNMP sysName parameter is not set to the module part number, but is instead the device name.

The following properties can be viewed and edited in the **SNMP** page:

| Property | Description |
|---|---|
| IP Address Managers: | |
| IP Address Manager 1 | The IP address of the first SNMP manager to which the SNMP agent sends notices of traps. |
| IP Address Manager 2 | The IP address of the second SNMP manager to which the SNMP agent sends notices of traps. |
| Agent: | |
| Location | The device location (32 characters maximum) |
| Contact | Information describing the person to contact for device maintenance (32 characters maximum) |
| SNMP Manager | Select either:<br>● **TRUE**: the Location and Contact information are editable in this page<br>● **FALSE**: Location and Contact settings are not editable in this page |
| Community Names: | |
| Get | Password required by the SNMP agent before executing read commands from an SNMP manager.<br>Default = **public**. |

| Property | Description |
|---|---|
| Set | Password required by the SNMP agent before executing write commands from an SNMP manager.<br>Default = **public** |
| Trap | Password an SNMP manager requires from the SNMP agent before the manager will accept trap notices from the agent. Default = **public** |
| Security: | |
| Enable Authentication Failure Trap | **TRUE** causes the SNMP agent to send a trap notification message to the SNMP manager if an unauthorized manager sends a Get or Set command to the agent. Default = **FALSE**. |

# Configuring Access Control

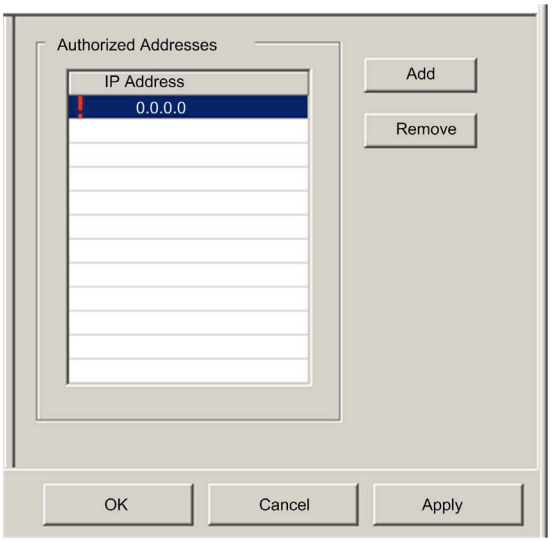
## Description

Use the **Access Control** page to restrict access to the Ethernet communication module in its role as either a Modbus TCP or EtherNet/IP server. When access control is enabled in the **Services** page, add the IP addresses of the following devices to the list of **Authorized Addresses** to permit communication with that device:

- the Ethernet communication module itself, so that the module can use EtherNet/IP explicit messaging for any of the following purposes:
  - obtaining diagnostic data
  - resetting the module
  - changing the IP address
- any client device that may send a request to the Ethernet communication module, in its role as either Modbus TCP or EtherNet/IP server
- your own maintenance PC, so that you can communicate with the PLC via Unity Pro to configure and diagnose your application, and to view the module's web pages
- any target device to which the Ethernet communication module may send a Modbus TCP explicit message
  **NOTE:** You need not add to list the IP address of devices that will be the target of EtherNet/IP explicit messages.

When access control is disabled in the **Services** page, the Ethernet communication module will accept Modbus TCP and EtherNet/IP requests from any device.

The following graphic depicts the **Access Control** page immediately after a new row has been added to the list of **Authorized Addresses**, but before the new item has been configured:



To display this page:

| Step | Description |
|---|---|
| 1 | Select the **Services** node in the navigation tree located on the left side of the **Device Editor**. The **Services** page opens. |
| 2 | In the **Services** page, set the **Access Control** field to **Enabled** and click either **OK** or **Apply**. The **Access Control** node appears in the navigation tree. |
| 3 | Select the **Access Control** node in the navigation tree. |

**NOTE:** Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to edit properties.

## Adding and Removing Devices in the Authorized Address List

To add a device to the **Authorized Addresses** list:

| Step | Description |
|---|---|
| 1 | In the **Access Control** page, click **Add**.<br>A new row appears in the **Authorized Addresses** list, displaying:<br>● a red exclamation point, indicating editing has begun, and<br>● a placeholder IP address of 0.0.0.0 |
| 2 | Double-click the left mouse button on the placeholder IP address.<br>The IP address field expands and becomes editable. |
| 3 | In the new IP address field, type in the IP address of the device which will be able to access the communication module, then press **Enter**. |
| 4 | Repeat steps 1 through 3, above, for each additional device to which you want to grant access to the communication module. |
| 5 | Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to save your configuration edits. |

To remove a device from the **Authorized Addresses** list, select its IP address in the list, then click **Remove**. The selected IP address is removed.

# Configuring QoS Ethernet Packet Tagging

## Description

The Ethernet communication module can be configured to perform Ethernet packet tagging. The module supports the OSI layer 3 Quality of Service (QoS) standard defined in RFC-2475. When you enable QoS, the module adds a *differentiated services code point* (DSCP) tag to each Ethernet packet it transmits, thereby indicating the priority of that packet.

Use the **QoS** page to:

- specify the source of QoS packet priority settings, and
- view or edit QoS DSCP prioritization values

The contents of the **QoS** page depends on the Ethernet communication module you selected for your project: **BMX NOC 0401** or **BMX NOC 0401.2**.

**NOTE:** The DSCP Value settings input in the **QoS** page are synchronized with the same settings in the **QoS Queue** tab of the **Channel Properties** →**Switch** page. Edits to a common property in either page will change that value in the other page.

The **QoS** page displays five EtherNet/IP traffic types when you are operating in **Advanced Mode** *(see page 47)*, or two EtherNet/IP traffic types when Advanced Mode is de-selected.

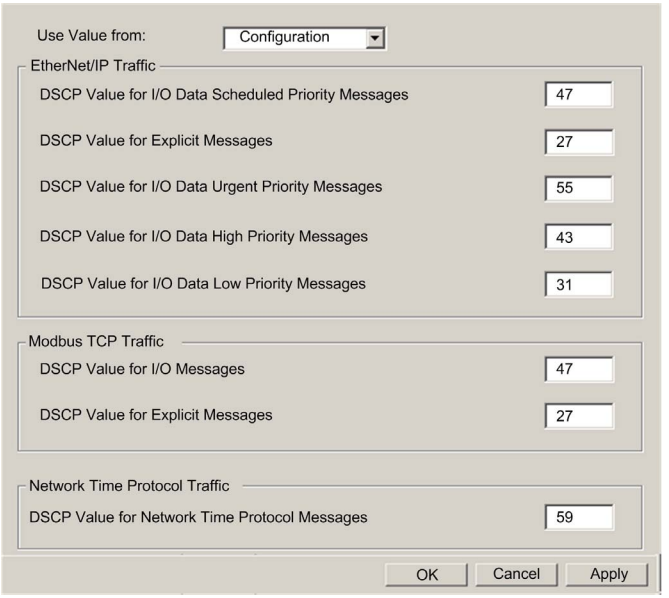
To display the **QoS** page:

| Step | Description |
|---|---|
| 1 | Select the **Services** node in the navigation tree located on the left side of the **Device Editor**. The **Services** page opens. |
| 2 | In the **Services** page, set the **QoS Tagging** field to **Enabled**, then click **OK** or **Apply**. The **QoS** node appears in the navigation tree. |
| 3 | Select the **QoS** node in the navigation tree. |

**NOTE:** Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to edit properties.

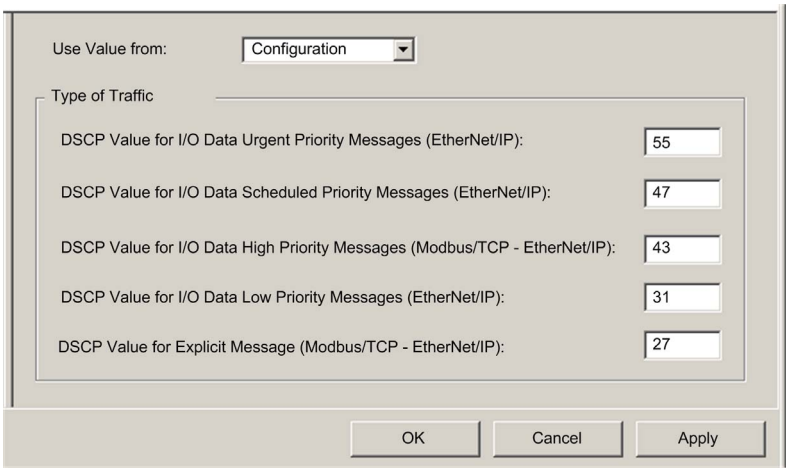
## The QoS Page for the BMX NOC 0401.2 Ethernet Communication Module

The following **QoS** page displays the default values for the **BMX NOC 0401.2** module displays when operating in **Advanced Mode**:




## The QoS Page for the BMX NOC 0401 Ethernet Communication Module

The following **QoS** page displays the default values for the **BMX NOC 0401** module displays when operating in **Advanced Mode**:



## Specifying the Source of QoS Settings

The five QoS prioritization values can be set either from the communication module's flash memory, or in this page. To specify the QoS configuration source, set the **Use value from** field to either:

| Setting | Description |
|---|---|
| Configuration[1] | The communication module uses the settings input in the **Type of Traffic** section of this page. |
| Flash[1] | The communication module uses the settings saved in the module's flash memory. The fields in the **Type of Traffic** section are read-only. |
| 1. Schneider Electric recommends that QoS values be set in the configuration, and not by saving settings to flash memory. Settings saved to flash memory will be lost if the module is replaced. | |

**NOTE:** You can also edit QoS configuration settings by using explicit messages to set the attributes of the QoS CIP object *(see page 237)*.

## Type of Traffic Settings

QoS tagging lets you prioritize Ethernet packet streams based on the type of traffic in that stream. The communication module recognizes the traffic types described below. When the **Use value from** field is set to **Configuration**, you can edit the prioritization values in this page. Each traffic type can have a prioritization value from 0... 63.

| Traffic Type | Default |
|---|---|
| DSCP Value for IO Data Scheduled Priority Messages (EtherNet/IP) | 43 |
| DSCP Value for Explicit Message (Modbus TCP & EtherNet/IP) | 27 |
| DSCP Value for IO Data Urgent Priority Messages (EtherNet/IP)[1] | 55 |
| DSCP Value for IO Data High Priority Messages (Modbus TCP & EtherNet/IP)[1] | 43 |
| DSCP Value for IO Data Low Priority Messages (EtherNet/IP)[1] | 31 |
| DSCP Value for Network Time Protocol Messages | 59 |
| 1. Visible only when Advanced Mode *(see page 47)* is enabled. | |

To effectively implement QoS settings in your Ethernet network:

- use network switches that support QoS
- consistently apply DSCP values to network devices and switches that support DSCP
- verify that switches apply a consistent set of rules for sorting DSCP tags, when transmitting and receiving Ethernet packets

**NOTE:** The QoS settings for Scheduled, High, and Low priority messages also apply to input and output priority messages for a remote device. You can configure these settings for a remote device in the **Device Editor** by selecting a device connection node, then opening the connection's **General** page.

# Configuring the Rapid Spanning Tree Protocol

## Description

Ethernet ports 3 and 4, located on the front of the BMX NOC 0401 communication module, support the *Rapid Spanning Tree Protocol* (RSTP). RSTP is an OSI layer 2 protocol defined by IEEE 802.1D 2004. RSTP performs two necessary services:

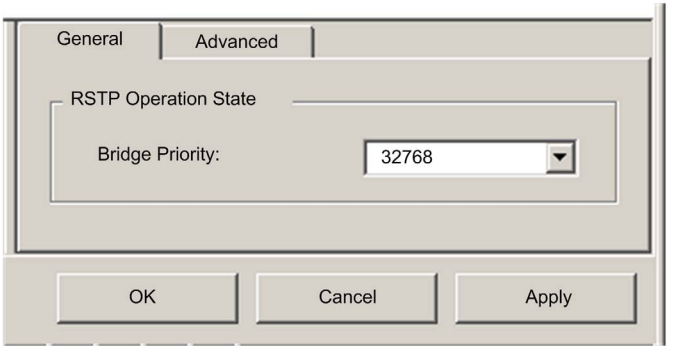
- it creates a loop-free logical network path for Ethernet devices that are part of a topology that includes redundant physical paths
- it automatically restores network communication—by activating redundant links—in the event the network experiences a loss of service

RSTP software, operating simultaneously in every network switch, obtains information from each switch which enables the software to create a hierarchical logical network topology. RSTP is a flexible protocol that can be implemented on many physical topologies, including ring, mesh, or a combination of ring and mesh.

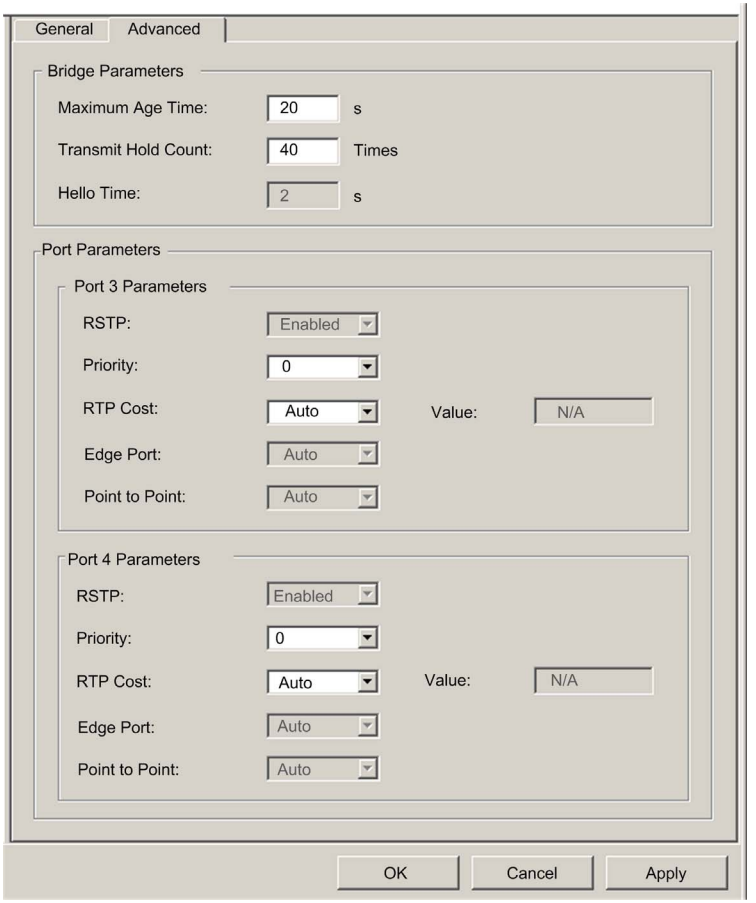
Use the **RSTP →General** and the **RSTP →Advanced** pages to configure RSTP for the embedded Ethernet switch in the communication module.

**NOTE:** RSTP can be implemented only when every network switch is configured to support RSTP.

The **RSTP →General** page looks like this:



The **RSTP** →**Advanced** page looks like this:




To display these pages:

| Step | Description |
|---|---|
| 1 | Select the **Services** node in the navigation tree located on the left side of the **Device Editor**. The **Services** page opens. |
| 2 | In the **Services** page, set the **RSTP** field to **Enabled**, then click **OK** or **Apply**. The **RSTP** node appears in the navigation tree. |
| 3 | Select the **RSTP** node in the navigation tree, then click on either the **General** or **Advanced** tab to display that page. |

**NOTE:** Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to edit properties.

## Configuring RSTP Properties

The following properties can be viewed and edited in the **RSTP →General** page:

| Property | Description |
|---|---|
| RSTP Operation State:<br>Bridge Priority | A 2-byte value for the switch, from 0 to 65535, with a default of 32768 (the midpoint).<br>**NOTE:** Network switches running RSTP software periodically exchange information about themselves using special packets called Bridge Protocol Data Units (BPDUs), which act as a heartbeat. The Bridge Priority value is contained in the BPDU and establishes the relative position of the switch in the RSTP hierarchy. |

The following properties can be viewed and edited in the **RSTP →Advanced** page:

| Property | Description |
|---|---|
| Bridge Parameters: | |
| Maximum Age Time | This value is set to The length of time, from 6 to 40 seconds, that the switch waits for receipt of the next hello message, before initiating a change to the RSTP topology. Default = 40 s. |
| Transmit Hold Count | The maximum number of BPDUs, from 1 to 40, that the switch can transmit per second. Default = 40. |
| Hello Time | (read-only) The frequency—set at 2 seconds—that the embedded switch sends heartbeat BPDUs. |
| Port Parameters (These properties can be separately configured for ports 3 and 4): | |
| RSTP | (read-only) This property is set to **Enabled** in the **Services** page. |
| Priority | The priority assigned to the switch port, an integer from 0 to 240 in increments of 16. Default = 0. This value is used by the RSTP process if it needs to break a tie between two ports on the same switch when identifying a:<br>● root port: the port on a non-root switch that is closest to the root bridge in terms of path cost, or<br>● designated port: the port at one end of a network segment through which traffic passes on its way to the root bridge |
| RSTP Cost | The method used to determine the RSTP cost of the path through the embedded switch. Values include:<br>● **Auto**—the RSTP protocol will automatically assign a value to the switch by operation of the RSTP algorithm<br>● **Manual**—you input the RSTP cost—an integer from 1 to 200000000—in the **Value** field. |
| Edge Port | (read-only) Set to a fixed value of **Auto**. The RSTP process automatically determines if the port is an RSTP edge port. |
| Point to Point | (read-only) Set to a fixed value of **Auto**. The RSTP process automatically determines if the port is an RSTP point-to-point port. |

# Configuring the Email Service

## Using the Email Service

Use the Simple Mail Transfer Protocol (SMTP) service to configure up to three (3) Email messages. The PLC uses the Email messages you configure to notify specified Email recipients about meaningful run-time events—for example, a change in the value of a variable, or a threshold overrun.

**NOTE:** The Email service is available only when you first perform the following tasks:

- upgrade the firmware in the **BMX NOC 0401** Ethernet communication module to version 2.01 or higher
- select the **BMX NOC 0401.2** Ethernet communication module for your project using Unity Pro version 7.0 or higher

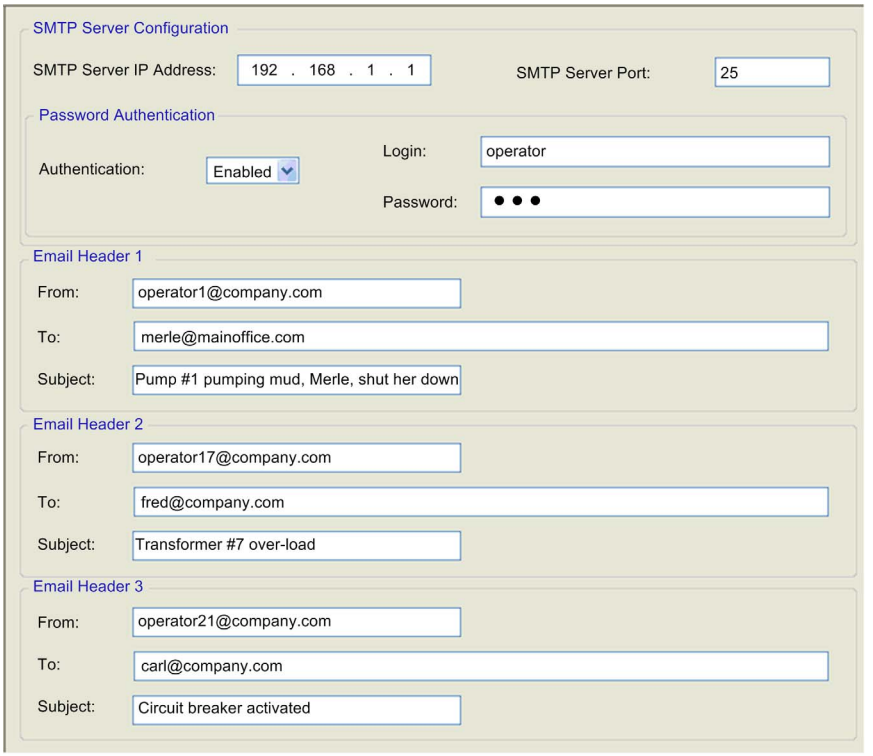
Email messages are transmitted by the execution of a `SEND_EMAIL` *(see page 95)* function block included in your application logic.

**NOTE:** To successfully send an Email message using the `SEND_EMAIL` block, the Email service and PLC application must be synchronized—i.e., the Email service must be activated whenever the PLC is in RUN mode.

You can configure the Email service only in the **Email Configuration** page of Unity Pro. You can diagnose the operation of the Email service in the diagnostic pages of both the Unity Pro software *(see page 308)* and the communication module web pages *(see page 366)*.

## Configuring Email Service Parameters

Use the following page to configure up to three Email messages:




To display this page:

| Step | Description |
|---|---|
| 1 | Select the **Services** node in the navigation tree located on the left side of the **Device Editor**. The **Services** page opens. |
| 2 | In the **Services** page, set the **Email** field to **Enabled**. The **Email** node appears in the navigation tree. |
| 3 | Select the **Email** node in the navigation tree. |

## Viewing and Configuring Email Settings

The configurable Email service parameters include the following:

| Parameter | Description |
|---|---|
| SMTP Server Configuration: | |
| SMTP Server IP Address: | The IP address of the Email server that will relay Email messages. |
| SMTP Server Port: | TCP port used by the Email server. Default = 25. |
| Password Authentication: | |
| Authentication: | Is client authentication by the Email server:<br>● Disabled (default)<br>● Enabled |
| Login: | If the Email server is configured for client authentication, the user name, up to 64 characters. |
| Password: | If the Email server is configured for client authentication, the client password string, up to 64 characters. |
| Email Header 1...3: | |
| From: | The Email address of the sender, up to 64 characters. |
| To: | The Email addresses of the recipients, up to 128 characters. |
| Subject: | The static part of the Email message, up to 32 characters. |

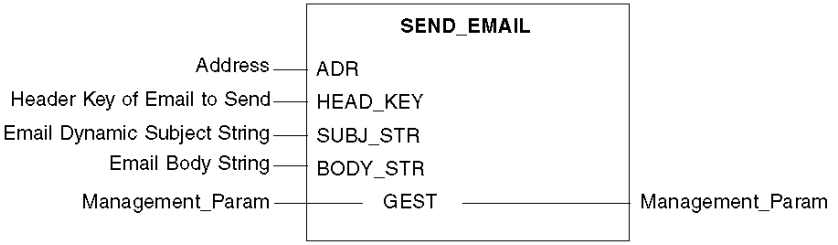
# Sending Email via the SEND_EMAIL Block

## Using SEND_EMAIL to Send Pre-configured Email Messages

Use the SEND_EMAIL block in your application to programmatically send any of three email messages you previously configured in Unity Pro *(see page 92)*.

**NOTE:** To successfully send an Email message using the SEND_EMAIL block, synchronize the Email client service and PLC application—i.e., activate the Email client service whenever the PLC is in RUN mode.

## FBD Representation




## Input Parameters

The following table describes the input parameters:

| Parameters | Data Type | Description |
|---|---|---|
| ADR | ARRAY [0...7] OF INT | The path to the destination device, in the format of *rack.slot.channel*.<br>Use the EFB ADDR to convert from the string format to the array of INT. For example, if the module is configured at rack 0, slot 4, channel 0, use: ADDR('0.4.0'). |
| HEAD_KEY | INT | The email header number previously configured in Unity Pro *(see page 92)*. Only values of 1, 2, and 3 are valid). |
| SUBJ_STR | STRING | The dynamic part of the email subject that is appended to the static subject string. |
| BODY_STR | STRING | The body of the email.<br>**NOTE:** Use the **$N** (or **$n**) two-character tag to insert a line break in the email text. |

## Input / Output Parameters

The following table describes the GEST management parameter, which is the only input/output parameter:

| Parameters | Data Type | Description |
|---|---|---|
| GEST | ARRAY [0...3] OF INT | The management parameter, consisting of 4 words. |

The GEST management parameter presents the following structure:

| Description | Word Order | MSB | LSB |
|---|---|---|---|
| System-managed data | 1 | Exchange number | Activity bit—the first bit of the first word. It indicates the execution status of the communication:<br>● 1 = Email is being sent<br>● 0 = Email complete |
| | 2 | Operation report *(see page 396)* | Communication report *(see page 395)* |
| User-managed data | 3 | Timeout | |
| | 4 | Length: the size of the data buffer.<br>**NOTE:** The length parameter is an output parameter. This word is written by the system and equals the total length of the email (header + body). The maximum size of header + body is 1024 characters. | |

# Configuring the Network Time Service

## The Network Time Protocol Client

The Ethernet communication module includes a network time protocol (NTP) client. After you enable the network time service *(see page 73)*, you can configure it by:

- identifying two external NTP servers—a primary server, and a secondary server—the Ethernet communication module uses to synchronize its internal time setting
- specifying the time zone location of the module
- enabling the automatic adjustment of the module internal time setting for daylight saving time changes

The Ethernet communication module sends its internal time setting to the PLC controller over the shared backplane. The PLC manages an internal clock to maintain this time, and uses the time setting to time-stamp system events and I/O data.

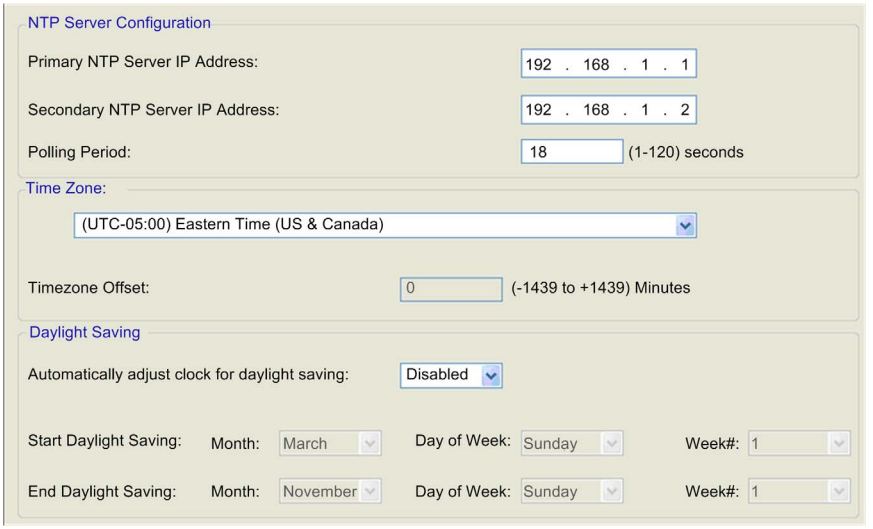
**NOTE:** The network time service is available only when you first perform the following tasks:

- upgrade the firmware in the **BMX NOC 0401** Ethernet communication module to version 2.01 or higher
- select the **BMX NOC 0401.2** Ethernet communication module for your project using Unity Pro version 7.0 or higher

Operation of the network time service can be monitored and diagnosed in:

- the Network Time Service Diagnostics page of the Unity Pro software *(see page 319)*, and
- the Network Time Service web page *(see page 385)*

You can configure the network time only in the following page:



To display this page:

| Step | Description |
|---|---|
| 1 | Select the **Services** node in the navigation tree located on the left side of the **Device Editor**. The **Services** page opens. |
| 2 | In the **Services** page, set the **Network Time Service** field to **Enabled**. The **Network Time Service** node appears in the navigation tree. |
| 3 | Select the **Network Time Service** node in the navigation tree. |

## Viewing and Configuring Network Time Service Settings

The following settings can be viewed and edited in this page:

| Property | Description | |
|---|---|---|
| NTP Server Configuration: | | |
| Primary NTP Server IP Address | The IP address of the NTP server, from which the Ethernet communication module first requests a time setting. | |
| Secondary NTP Server IP Address | The IP address of the back-up NTP server, from which the Ethernet communication module requests a time setting, after not receiving a response from the primary NTP server. | |
| Polling Period | The frequency (1...120 seconds) the Ethernet communication module uses for requesting a time setting from the NTP server. Default = 18 seconds. | |
| Time Zone: | | |
| Time Zone Setting | The time zone associated with the Ethernet communication module, selected from a list that includes time zones around the globe. Default = Greenwich Mean Time (GMT) + 0 minutes. | |
| Timezone Offset | The number of minutes (–1439...+1439) used to adjust the Time Zone Setting. Default = 0 minutes. | |
| Daylight Saving: | | |
| Automatically adjust clock for daylight saving | • Enabled: turns ON the automatic clock adjustment for daylight savings.<br>• Disabled: turns OFF the automatic clock adjustment for daylight savings.<br>Default = Disabled.<br>If automatic adjustment of the clock for daylight savings is enabled, use the next two fields to configure daylight saving adjustments. | |
| Start Daylight Saving | Month | Select the month daylight savings begins. Default = March. |
| | Day of Week | Select the day of the week daylight savings begins. Default = Sunday. |
| | Week# | Select the week of the month daylight savings begins. Default = 1 (fist week of the month). |

| Property | Description | |
|---|---|---|
| End Daylight Saving | Month | Select the month daylight savings ends. Default = November. |
| | Day of Week | Select the day of the week daylight savings ends.<br>Default = Sunday. |
| | Week# | Select the week of the month daylight savings ends. Default = 1 (fist week of the month). |

# Section 2.6
# Security

## Security Features

### Security and HTTP, FTP, and TFTP Services

You can enhance security for your project by disabling the FTP/TFTP and HTTP services at times when you do not need to use them. The module uses the HTTP service to provide access to the embedded webpages. The module uses the FTP and TFTP services to support various features including firmware upgrades, and FDR services.

The module's HTTP, FTP, and TFTP services can be disabled or enabled using the **DTM Browser Security** screen.

HTTP, FTP, and TFTP services are disabled by default in DTM instances created using BMX NOC 0401 module firmware version 2.04 or later and Unity Pro version 8.1 or later. They are enabled by default in instances created using previous versions of Unity Pro.

You can use Unity Pro to enable or disable HTTP, FTP, and TFTP services as described in the following procedure.

If the HTTP, FTP, or TFTP services have been enabled with Unity Pro, they can also be enabled or disabled at run time using a DATA_EXCH function block. (See the *Communication Block Library* for Unity Pro.)

### Using Unity Pro to Enable and Disable Firmware Upgrade & FDR and Web Access Services

Perform the following steps to enable or disable FTP/TFTP or HTTP services on the module.

| Step | Action |
|---|---|
| 1 | In the Unity Pro main menu, select **Tools** →**DTM Browser** to open the **DTM Browser**. |
| 2 | Confirm that the DTM you want to use is not connected to the actual communication module or device. If necessary, disconnect the DTM from the module or device *(see page 43)*. |
| 3 | In the **DTM Browser**, select the module. Right-click and select **Open** to open the **Device Editor**. |
| 4 | Click the **Security** node in the navigation tree in the left panel to open the **Security** screen. |
| 5 | On the **Security** screen, choose the appropriate setting: (**Enabled** or **Disabled**) for the service or services. |
| 6 | Click:<br>● **Apply** to save the changes and keep the window<br>- or -<br>● **OK** to save the changes and close the window |

The edits do not take effect until they are successfully downloaded from your PC to the CPU and from the CPU to the communication modules and network devices.

# Section 2.7
## Configuring the Ethernet Communication Module as an EtherNet/IP Adapter

### Overview

This section describes how to configure the Ethernet communication module to act as an EtherNet/IP adapter, using a functionality called Local Slave. The communication module supports up to three instances of local slaves.

In its role as a EtherNet/IP adapter, the module initiates no messages. Instead, it responds to:

- implicit messaging requests from a scanner device in the network, and
- explicit messaging requests—directed to the communication module's assembly object *(see page 231)*—from other devices on the network
  **NOTE:** If no local slave instance is enabled, the communication module can respond to explicit messaging requests directed at its CIP objects *(see page 227)* other than the assembly object.

### What Is in This Section?

This section contains the following topics:


| Topic | Page |
|---|---|
| Introducing the Local Slave | 102 |
| Configuring a Local Slave | 104 |
| Local Slave Inputs and Outputs | 109 |

# Introducing the Local Slave

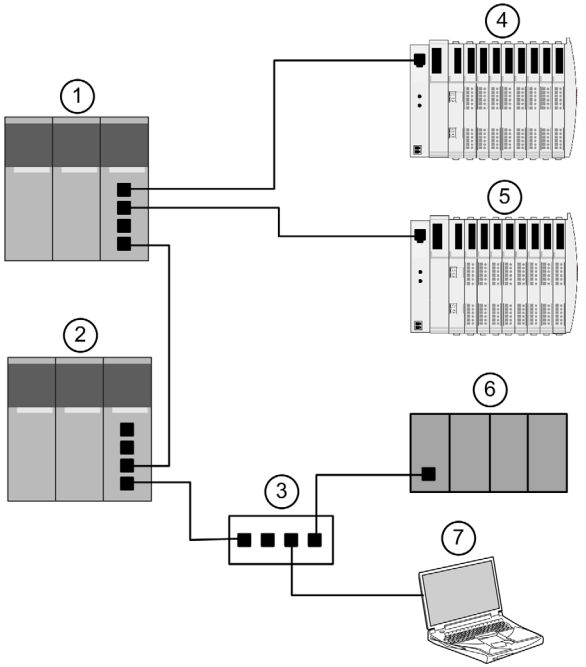
## Local Slave Networking Example

The Ethernet communication module supports up to three instances of the local slave functionality. The local slave functionality allows other scanners on the network to read from, and write to, the Ethernet communication module using implicit messaging. Each local slave instance can accept one exclusive owner connection and one listen only connection. Through a local slave, a remote scanner can access the communication module's CIP Assembly object *(see page 231)*. The local slave function is especially beneficial for peer to peer data exchanges at a repetitive rate.

**NOTE:**

- The Ethernet communication module can provide three local slave adapter instances, while simultaneously performing as a scanner. These roles are not mutually exclusive.
- The local slave is exclusively an EtherNet/IP functionality

In this example, the local slave instance is part of the following topology:




The sample configuration, above, includes the following devices:

- A primary PLC (1) incorporating the BMX NOC 0401 Ethernet communication module with one local slave instance enabled. The PLC scans I/O data from remote devices (4 and 5)
- A secondary PLC (2) that "listens" to the scan of the primary PLC's local slave by the third-party PLC (6)
- A managed Ethernet switch (3)

- An Advantys STB island (4), with an STB NIC 2212 EtherNet/IP network interface module plus 8 I/O modules
- An Advantys STB island (5), with an STB NIP 2212 Modbus TCP network interface module plus 8 I/O modules
- A third party scanner (6)—which lacks adapter capability, and therefore cannot itself be scanned by the primary PLC (1)—that:
  - collects data from other sources (not part of this network)
  - writes data to inputs of the primary PLC's local slave
  - scans the primary PLC's local slave's output data via an exclusive owner connection
- A PC running the following software:
  - Unity Pro
  - the Unity Pro Configuration Tool
  - Advantys Configuration Software

**NOTE:**

- Because the third party scanner (6) and the secondary scanner (2) are both receiving the same data produced by the local slave, configure the requested packet interval (RPI) setting of the third party scanner's exclusive owner connection and the secondary scanner's listen only connection to the same setting.
- By enabling a local slave on the primary PLC (1):
  - PLC (1) allows the third party PLC (6) to write to it at a repetitive rate, even if PLC (6) is not capable of acting as an adapter.
  - the secondary PLC (2) is able to scan the primary PLC (1) at a repetitive rate, rather than through application intensive explicit messaging.

The topics in this section show you how to use Unity Pro software installed in the PC (7, above) to configure a local slave, and to create input and output items in support of the peer-to-peer data transfers between and among scanners.

# Configuring a Local Slave

## Description

The Ethernet communication module presents three identical **Local Slave** configuration pages. Use each page to configure a separate local slave instance. Create a local slave instance by:

- enabling and naming the local slave
- specifying the size of local slave input and output assemblies
- configuring local slave variable names

To display this page, select one of the three **Local Slave** nodes in the navigation tree located on the left side of the **Device Editor**.

**NOTE:** Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to edit properties.

The following steps describe a sample configuration for **Local Slave 1**. Your configuration may be different.

## Configuration Example: Local Slave 1

In the sample network configuration, the application in the third-party PLC produces data, which is available in the PLC's Ethernet communication module as inputs. In this example, the third-party device produces the following information:

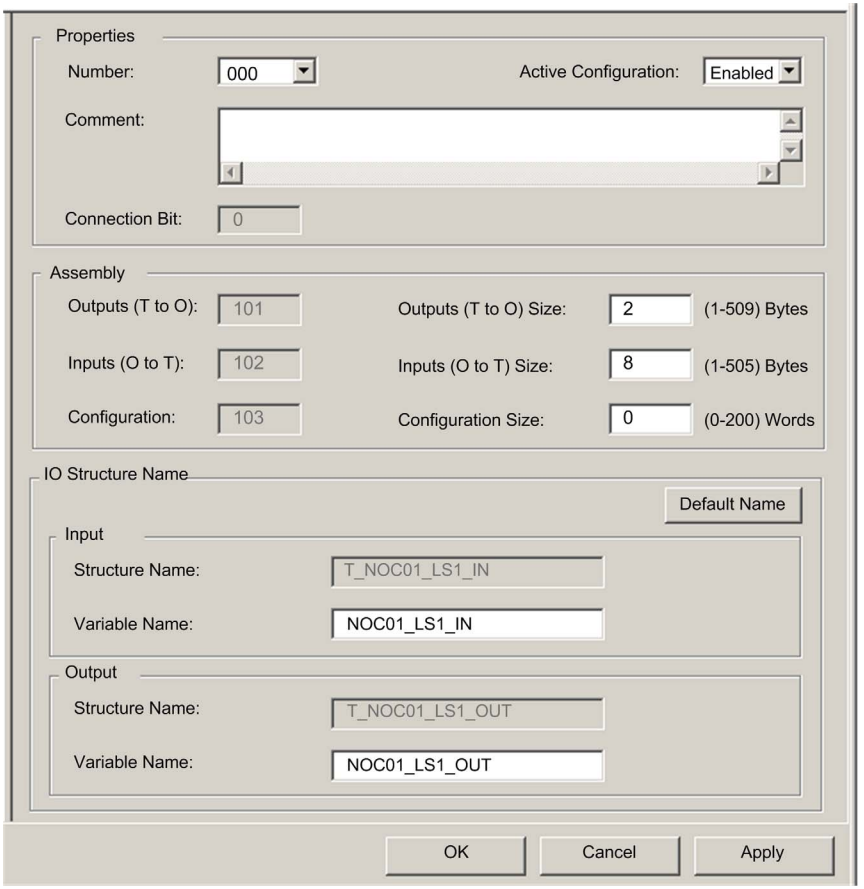
- production totals for manufacturing line A
- production totals for manufacturing line B
- the number of production interruption events for line A
- the number of production interruption events for line B

Any information that needs to be passed to the third-party device—for example, confirmation that data from the third-party device has been received by the PLC—is accessible in the third-party device as input data. In this example, the third-party device is programmed to scan Local Slave 1 for this confirmation.

When configuring inputs and outputs in both the local slave and the third-party PLC, associate inputs and outputs as follows:

| Associate these local slave items: | With these third-party PLC items: |
|---|---|
| Outputs (T to O)—assembly instance 101 | Inputs—assembly instance 101 |
| Inputs (O to T)—assembly instance 102 | Outputs—assembly instance 102 |

The configured **Local Slave** page looks like this:




## Enabling and Naming the Local Slave

Use the **Properties** section of the **Local Slave** page to enable (or disable) and identify the local slave.

| Setting | Description |
|---|---|
| Number | The unique number—or identifier—assigned to the device. By default, Unity Pro assigns:<br>● 000 = local slave 1<br>● 001 = local slave 2<br>● 002 = local slave 3<br>In this example, accept the default **000**. |

| Setting | Description |
|---|---|
| Active Configuration | ● **Enabled** activates the local slave.<br>● **Disabled** de-activates the local slave, but retains the current local slave settings.<br>In this example, select **Enabled**. |
| Comment | An optional free text comment field up to 80 characters maximum.<br>In this example, leave blank. |
| Connection bit | Auto-generated integer (0...127) indicating the offset of the connection's:<br>● health bit, located in the module's input area<br>● control bit, located in the module's output area<br>**Note:** This setting is auto-generated after the local slave settings are input and the network configuration is saved. |

## Configuring the Size of Local Slave Input and Output Assemblies

Use the **Assemblies** section of the **Local Slave** page to configure the size of the local slave inputs and outputs. The assembly numbers are non-editable, and are assigned by Unity Pro as follows:

| Assembly number | Local slave number | Used for connection |
|---|---|---|
| 101 | 1 | T->O [1] |
| 102 | 1 | O->T Exclusive Owner |
| 103 | 1 | Configuration |
| 199 | 1 | O->T Listen Only |
| 111 | 2 | T->O |
| 112 | 2 | O->T Exclusive Owner |
| 113 | 2 | Configuration |
| 200 | 2 | O->T Listen Only |
| 121 | 3 | T->O |
| 122 | 3 | O->T Exclusive Owner |
| 123 | 3 | Configuration |
| 201 | 3 | O->T Listen Only |

1. In this table:
- O indicates the originator—or scanner—device
- T indicates the target—or adapter—device

The **Local Slave** assembly settings include:.

| Setting | Description |
|---|---|
| Outputs (T->O) | A read-only value (see table, above).<br>In this example, **101**. |
| Outputs (T->O) Size | The maximum size—in bytes—reserved for local slave outputs. An integer from 1 to 509.<br>In this example, only two output bytes are used: type in **2**. |
| Inputs (O->T) | A read-only value (see table, above).<br>In this example, **102**. |
| Inputs (O->T) Size | The maximum size—in bytes—reserved for local slave inputs. An integer from 0 to 505.<br>In this example, only eight input bytes are used: type in **8**. |
| Configuration | A read-only value (see table, above).<br>In this example, **103**. |
| Configuration Size | A read-only value set to **0**. |

**NOTE:** When using explicit messaging to read the Ethernet communication module's assembly object, you need to allocate sufficient room for the response, because the size of the response will equal the sum of:

**NOTE:** the assembly size + Reply service (1 byte) + General Status (1 byte)

## Configuring Local Slave I/O Variable Names

Each input and output that Unity Pro creates for your application has both a non-editable structure name (used by Unity Pro to internally identify input and output items) and an editable variable name.

Use the **I/O Structure Name** section of the **Local Slave** page to:
- view and edit local slave input and output variable names
- view non-editable local slave structure names

The following property settings have been made in this example:

| Setting | Description |
|---|---|
| Input: | |
| Structure Name | The read-only name for input structures. By default, it is the concatenation of:<br>● the prefix T_<br>● the alias device name—in this case NOC01<br>● the device number—in this case 01<br>● the suffix _IN<br>In this case, the default would be T_NOC01_01_IN. |

| Setting | Description |
|---|---|
| Variable Name | The editable base name for input variables. By default, it is the concatenation of:<br>● the alias device name—in this case NOC01<br>● the device number—in this case 01<br>● the suffix _IN<br>In this case, the default would be NOC01_01_IN.<br>For this example, accept the default variable name. |
| Output: | |
| Structure Name | The read-only name for output structures. By default, it is the concatenation of:<br>● the prefix T_<br>● the alias device name—in this case NOC01<br>● the device number—in this case 01<br>● the suffix _OUT<br>In this case, the default would be T_NOC01_01_OUT. |
| Variable Name | The editable base name for output variables. By default, it is the concatenation of:<br>● the alias device name—in this case NOC01<br>● the device number—in this case 01<br>● the suffix _OUT<br>In this case, the default would be NOC01_01_OUT.<br>For this example, accept the default variable name. |

If you have edited one or more variable names, you can restore the default variable names by clicking on the **Default Name** button.

# Local Slave Inputs and Outputs

## Introduction

The Ethernet communication module serves as an adapter when the **Active Configuration** field is set to **Enabled** in the configuration window for one (or more) of the module's local slave nodes.

When a local slave instance of an Ethernet communication module is enabled, the designated memory location allocated to that instance is exposed to, and can be accessed by, other devices.

The I/O data exchange, between the remote device and the local slave, is configured as part of the remote device's configuration settings.

## Configuring the I/O Items

You can configure input and output items in groups of 1 or more single bits, 8-bit bytes, 16-bit words, 32-bit dwords, or 32-bit IEEE floating values. The number of items you create depends upon the data type and size of each item.

The process for creating and defining I/O items for the local slave is the same as for any adapter class device, and depends upon the type of items you wish to create.

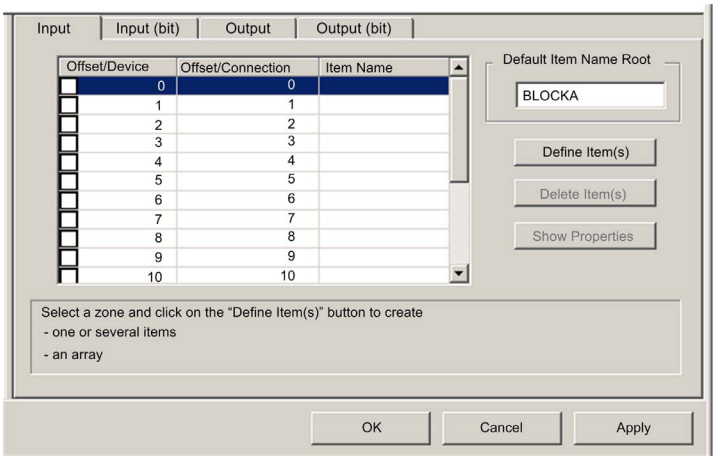
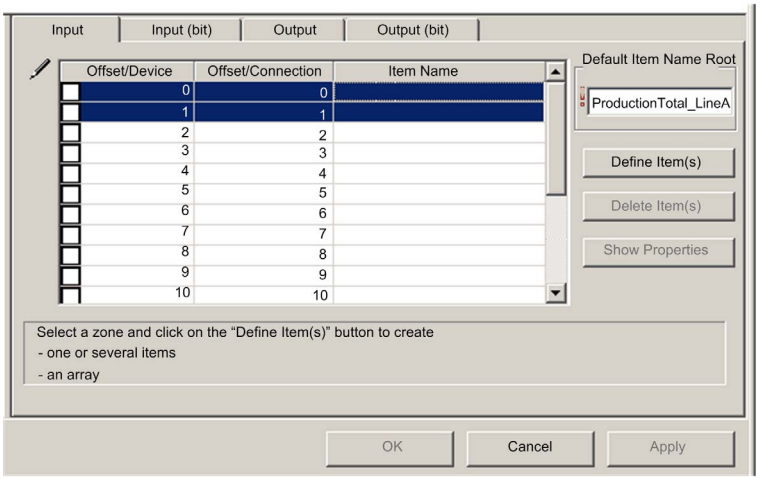
In support of the ongoing configuration example, the following items are required:

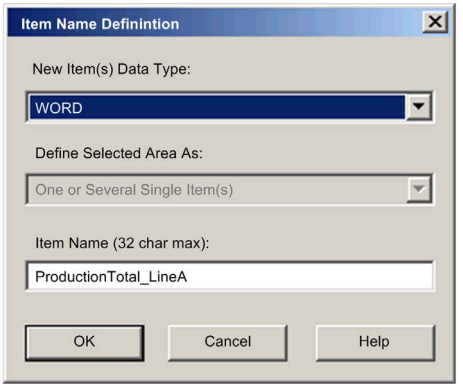
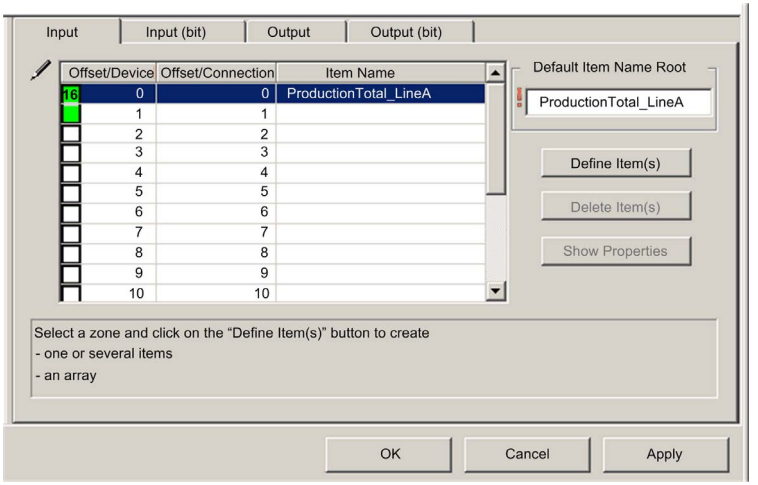
- 4 input word items
- 1 output word item

**NOTE:** The items created, below, are designed to hold data received from, or sent to, the third-party scanner. In addition to these items, it is necessary to include logic in the application programs in which the Ethernet communication module and the third-party scanner, respectively, are included. Writing this code is beyond the scope of this example.

## Creating Input Word Items

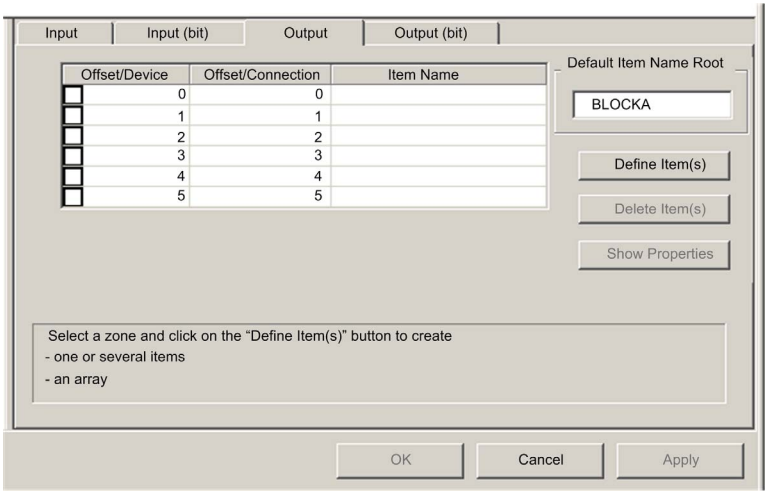
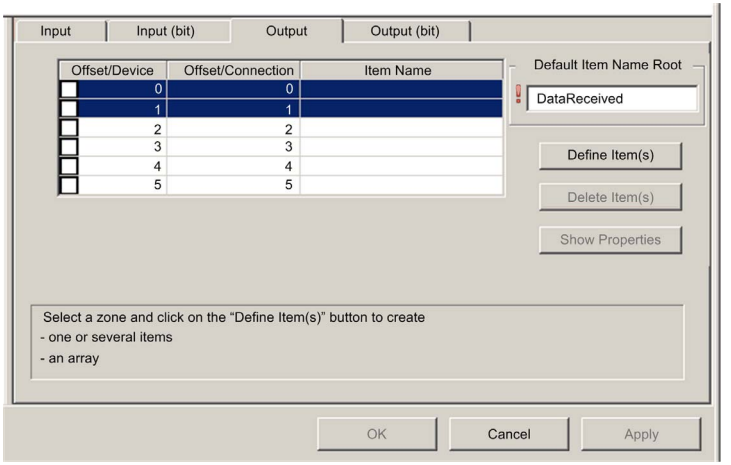
To create input items for local slave 01:

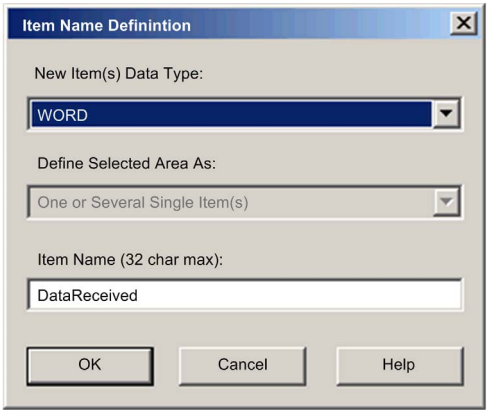
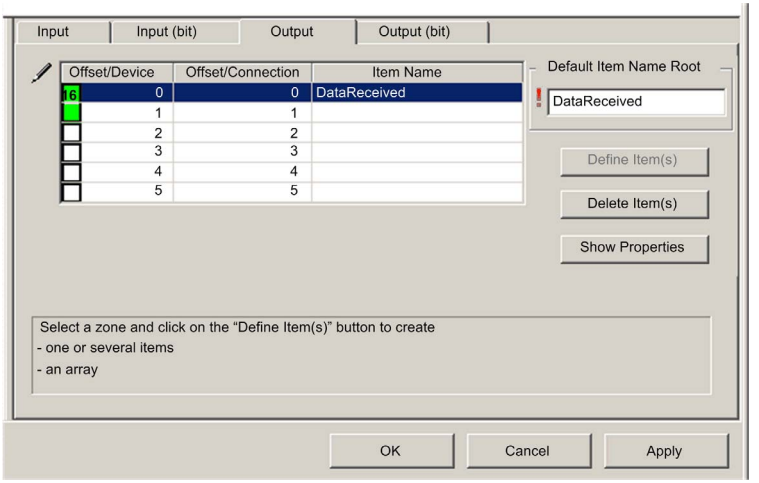
| Step | Action |
|---|---|
| 1 | Select the **Input** tab to open that page:<br>  <br>**NOTE:** In this example, each row represents a byte. Because the items you create will be a 16-bit words, each item consists of 2 rows. |
| 2 | In the **Default Item Name Root** input box type: **ProductionTotal_LineA**. |
| 3 | Starting at the beginning of the table, select the first two rows: 0 and 1:<br>  |

| Step | Action |
|---|---|
| 4 | Click the **Define Item(s)** button.<br>**Result**: The **Item Name Definition** dialog opens:<br>  |
| 5 | Select **WORD** as the **New Item(s) Data Type**, then click **OK**.<br>**Result**: A new item is created:<br>  |
| 6 | Click **Apply** to save the new items, and leave the page open. |
| 7 | Repeat steps 2 - 6 for each new word item you need to create. In this example, that includes the following items:<br>● Rows 2-3, Default Items Name Root: ProductionTotal_LineB<br>● Rows 4-5: Default Items Name Root: Events_LineA<br>● Rows 6-7: Default Items Name Root: Events_LineB |
| 8 | Create output words. |

## Creating Output Word Items

To create output items for local slave 01:

| Step | Action |
|---|---|
| 1 | Click the **Output** tab to open the following page:<br>  <br><br>**NOTE:** In this example, each row represents a byte. Because the only item you will create is a 16-bit word, you will select 2 rows. |
| 2 | In the **Default Item Name Root** input box type: **DataReceived**. |
| 3 | Starting at the beginning of the table, select the first 2 rows, 0 and 1:<br>  <br> |

| Step | Action |
|---|---|
| 4 | Click the **Define Item(s)** button.<br>**Result**: The **Item Name Definition** dialog opens:<br>  |
| 5 | Select **WORD** as the **New Item(s) Data Type**, then click **OK**.<br>**Result**: A new item is created:<br>  |
| 6 | Click **OK** to close the **Items** window. |
| 7 | Select **File** →**Save** to save your edits. |

## Using Local Slave Inputs and Outputs

The inputs and outputs created, above, are used as follows:

- The third-party device updates values of the following variables:
  - ProductionTotal_LineA
  - ProductionTotal_LineB
  - Events_LineA
  - Events_LineB
- The Ethernet communication module updates value of the DataReceived variable in the third-party device at the configured RPI.

# Chapter 3
# Adding Devices to an Ethernet Network

## Overview

This chapter presents examples of how to add devices to, and how to configure these device for operations on, your Ethernet network.

## What Is in This Chapter?

This chapter contains the following sections:


| Section | Topic | Page |
|---|---|---|
| 3.1 | Hardware Catalog | 116 |
| 3.2 | Adding an EtherNet/IP Device to the Network | 124 |
| 3.3 | Adding a Modbus TCP Device to the Network | 156 |

# Section 3.1
# Hardware Catalog

## Overview

Unity Pro includes a collection of modules and devices—called the **Hardware Catalog**—that you can add to a Unity Pro project. EtherNet/IP and Modbus TCP devices are located in the hardware catalog's **DTM Catalog** page. Each device in the catalog is represented by a DTM that defines the parameters of the module or device.

Not every device on the market today offer device-specific DTMs. Some devices are instead defined by a device-specific EDS file. Unity Pro displays each EDS file in the form of a DTM. In this way, you can use Unity Pro to configure these Ethernet/IP devices—defined by an EDS file—in the same way you would configure a DTM-defined device.

Other devices lack both a DTM and an EDS file. You can configure these devices by using a Generic DTM that is included in the **DTM Catalog** page.

This section address the topics:
- how to add a DTM to the catalog
- how to add an EDS file to the catalog
- how to update the catalog
- how to remove an EDS file from the catalog

## What Is in This Section?

This section contains the following topics:


| Topic | Page |
|---|---|
| Adding a DTM to the Unity Pro Hardware Catalog | 117 |
| Add an EDS File to the Unity Pro Hardware Catalog | 118 |
| Updating the Unity Pro Hardware Catalog | 120 |
| Remove an EDS File from the Unity Pro Hardware Catalog | 122 |

# Adding a DTM to the Unity Pro Hardware Catalog

## A Manufacturer Defined Process

Before a you can add a DTM to the Unity Pro **Hardware Catalog**, install it on the host PC—the same PC that is running Unity Pro—by means of an installation process defined by the device manufacturer.

Consult your device documentation, provided by the device manufacturer, for information describing how to install a device DTM on your PC.

For instructions on how to install the BMX NOC 0401 Ethernet communication module, refer to the topic Installing Unity Pro Ethernet Configuration Tool Software *(see page 23)*.

**NOTE:** After you successfully install a device DTM on your PC, update the Unity Pro Hardware Catalog *(see page 120)* so the new DTM is visible in the catalog and available to be added to a Unity Pro project.

# Add an EDS File to the Unity Pro Hardware Catalog

## Overview

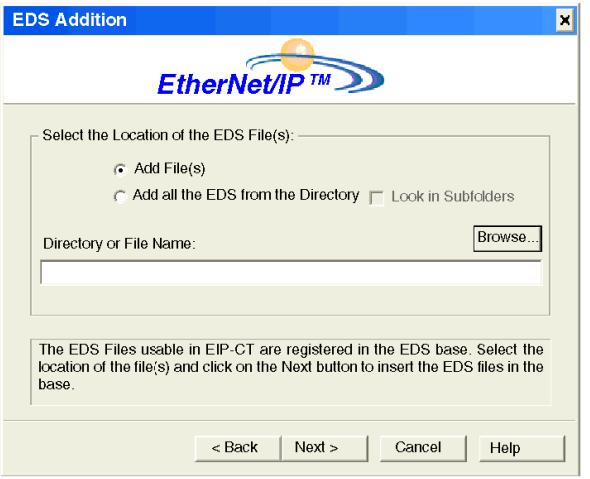
Unity Pro includes a wizard you can use to add one or more EDS files to the Unity Pro **Hardware Catalog**. The wizard presents a series of instruction screens that:

- simplify the process of adding EDS files to the catalog, and
- provide a redundancy check in case you attempt to add duplicate EDS files to the catalog

**NOTE:** The Unity Pro **Hardware Catalog** displays a partial collection of DTMs and EDS files registered with the ODVA. This library includes DTMs and EDS files for products not manufactured or sold by Schneider Electric. The non-Schneider Electric EDS files are identified by vendor in the catalog. Please contact the identified device's manufacturer for inquiries regarding the corresponding non-Schneider Electric EDS files.

## Adding EDS Files

To add one or more EDS files to the library:

| Step | Action |
|---|---|
| 1 | If the **DTM Browser** is not already open, in the Unity Pro main menu select **Tools** → **DTM Browser**. |
| 2 | In the **DTM Browser**, select a communication module, then click the right mouse button. A pop-up menu opens. |
| 3 | In the pop-up menu, select **Device menu** →**Add EDS to library**. The introductory page of the wizard opens. |
| 4 | Click **Next**. Page 2 of the wizard opens:  |

EDS Addition
EtherNet/IP ™
Select the Location of the EDS File(s):
Add File(s)
Add all the EDS from the Directory
Look in Subfolders
Directory or File Name:
Browse...
The EDS Files usable in EIP-CT are registered in the EDS base. Select the location of the file(s) and click on the Next button to insert the EDS files in the base.
< Back
Next >
Cancel
Help

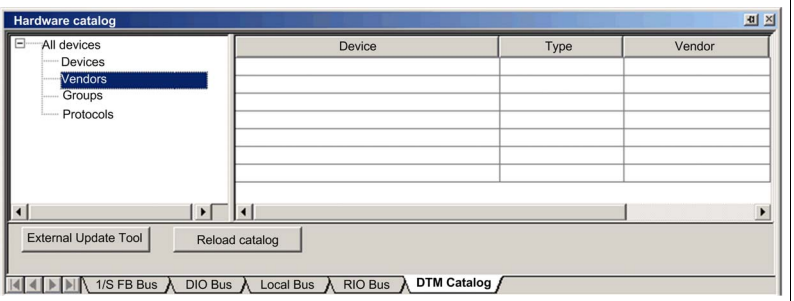
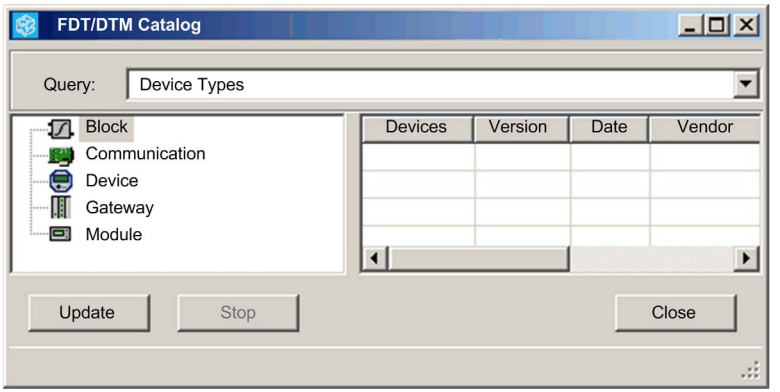
| Step | Action |
|---|---|
| 5 | In the **Select the Location of the EDS File(s)** section, select either:<br>● **Add File(s)**, to add one or more EDS files you will individually select, or<br>● **Add all the EDS from the Directory**, to add all files from a folder you will select.<br>  ● Select **Look in Subfolders** to also add EDS files in subfolders beneath the folder you selected. |
| 6 | Click the **Browse** button.<br>The **Open** dialog opens. |
| 7 | Use the **Open** dialog to navigate to and select:<br>● one or more EDS files, or<br>● a folder containing EDS files |
| 8 | After you have made your selections), click **Open**.<br>The dialog closes and your selection appears in the **Directory or File Name** field. |
| 9 | Click **Next**.<br>The wizard compares the selected EDS files against existing files in the library. |
| 10 | (Conditional) If one or more selected EDS files is a duplicate, a **File Already Exists** message opens.<br>**Close** the message. |
| 11 | Page 3 of the wizard opens indicating the Status of each device you attempted to add:<br>● a green check mark indicates the EDS file can be added<br>● a blue informational icon indicates a redundant file<br>● a red exclamation point  indicates an invalid EDS file<br>(Optional) Select a file in the list, then click **View Selected File** to open it. |
| 12 | Click **Next** to add the non-duplicate files.<br>Page 4 of the wizard opens, indicating the action is complete. |
| 13 | Click **Finish** to close the wizard. |
| 14 | The next step is to update the Unity Pro **Hardware Catalog** *(see page 120)*, so that the newly added device is available for inclusion in a Unity Pro project. |

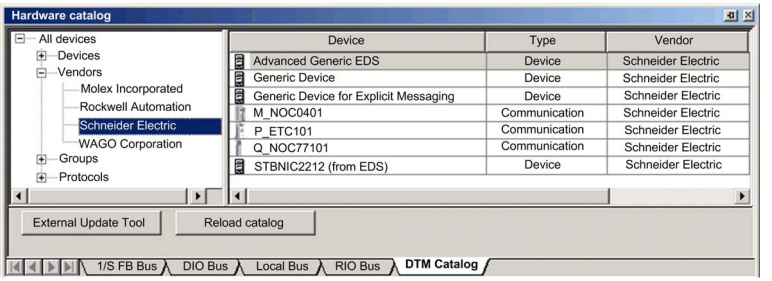
# Updating the Unity Pro Hardware Catalog

## Updating Hardware Catalog

After you have followed the manufacturer's instructions and installed a module or device DTM on your PC, the next step is to update the Unity Pro **Hardware Catalog**. Updating the **Hardware Catalog** makes the new Ethernet module or device available for addition to your Unity Pro application.

To update the **Hardware Catalog**:

| Step | Action |
|---|---|
| 1 | In the Unity Pro main menu, select **Tools** →**Hardware Catalog**. The **Hardware Catalog** window opens. |
| 2 | In the **Hardware Catalog** window, select the **DTM Catalog** tab to display a module and device DTM list. At the time of initial software installation, the catalog displays no devices:<br>  |
| 3 | Click the **External Update Tool** button. The **FDT/DTM Catalog** window opens:<br>  |
| 4 | In the **FDT/DTM Catalog** window, click **Update**. The window refreshes itself, as indicated by the progress bar in the lower right corner of the window. |

| Step | Action |
|---|---|
| 5 | After the update has finished, click **Close**. The **FDT/DTM Catalog** window closes and the **Hardware Catalog** displays. |
| 6 | In the **Hardware Catalog** window, click **Reload catalog** to refresh the DTM list.<br>  |

# Remove an EDS File from the Unity Pro Hardware Catalog

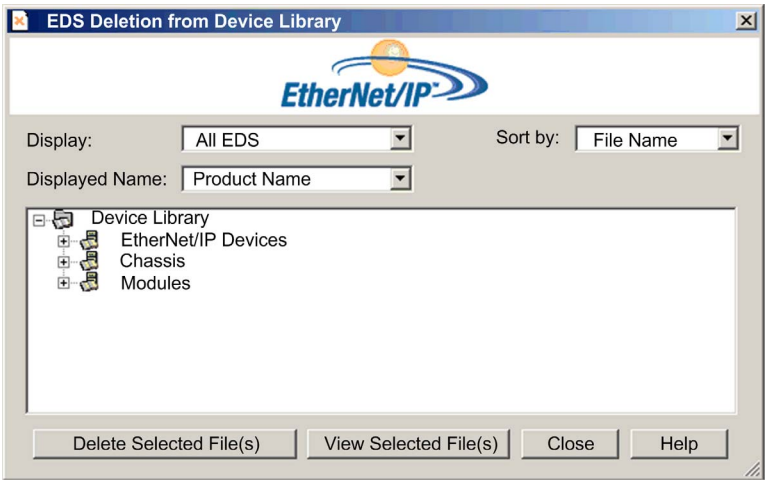
## Overview

You can remove a module or device from the list of available devices in the Unity Pro **Hardware Catalog** by removing its EDS file. When you remove an EDS file from the library, the device or module is no longer displayed by Unity Pro in the **DTM Catalog** page of the **Hardware Catalog** window.

However, removing an EDS file from the library does not delete the file. Instead, the EDS file remains in its stored location and can again be added to the catalog *(see page 118)* at a future time.

## Removing an EDS File from the Catalog

To remove an EDS file from the catalog:

| Step | Action |
|---|---|
| 1 | If the **DTM Browser** is not already open, in the Unity Pro main menu select **Tools** →**DTM Browser**. |
| 2 | In the **DTM Browser**, select a communication module, then click the right mouse button.<br>A pop-up menu opens. |
| 3 | In the pop-up menu, select **Device menu** →**Remove EDS from library**.<br>The following window opens:<br>  |

| Step | Action | |
|---|---|---|
| 4 | Use the selection lists in the heading of this window to specify how EDS files will be displayed: | |
| | **Display** | Filters the list of displayed EDS files; select:<br>• **All EDS** (no filtering)<br>• **Only Devices**<br>• **Only Chassis**<br>• **Only Modules** |
| | **Sort by** | Sorts the list of displayed EDS files; select:<br>• **File Name**<br>• **Manufacturer**<br>• **Category**<br>• **Device Name** |
| | **Displayed Name** | The description displayed for each device; select:<br>• **Catalog Name**<br>• **Product Name** |
| 5 | In the **Device Library** tree control, navigate to and select the EDS file you want to remove. | |
| 6 | (Optional) Click the **View Selected File** button to display the read-only contents of the selected EDS file. | |
| 7 | Click the **Delete Selected File** button. A message box opens. | |
| 8 | Click **Yes** to remove the selected EDS file from the list. | |
| 9 | When you have finished removing EDS files, click **Close**. | |
| 10 | The next step is to update the **Hardware Catalog** *(see page 120)*. | |

# Section 3.2
## Adding an EtherNet/IP Device to the Network

### Overview

This section extends the sample Unity Pro application, by describing how to:
- add an STB NIC 2212 EtherNet/IP network interface module to your Unity Pro application
- configure the STB NIC 2212 module
- configure EtherNet/IP connections linking the BMX NOC 0401 communication module and the STB NIC 2212 network interface module
- configure I/O items for the Advantys Island

**NOTE:** The instructions in this chapter describe a single, specific device configuration example. Refer to the Unity Pro help files for additional information about alternative configuration choices.

### What Is in This Section?

This section contains the following topics:


| Topic | Page |
|---|---|
| Setting Up Your Network | 125 |
| Adding an STB NIC 2212 Remote Device | 127 |
| Configuring STB NIC 2212 Properties | 129 |
| Configuring EtherNet/IP Connections | 134 |
| Connecting to the Advantys STB Island | 139 |
| Configuring I/O Items | 143 |

## Setting Up Your Network

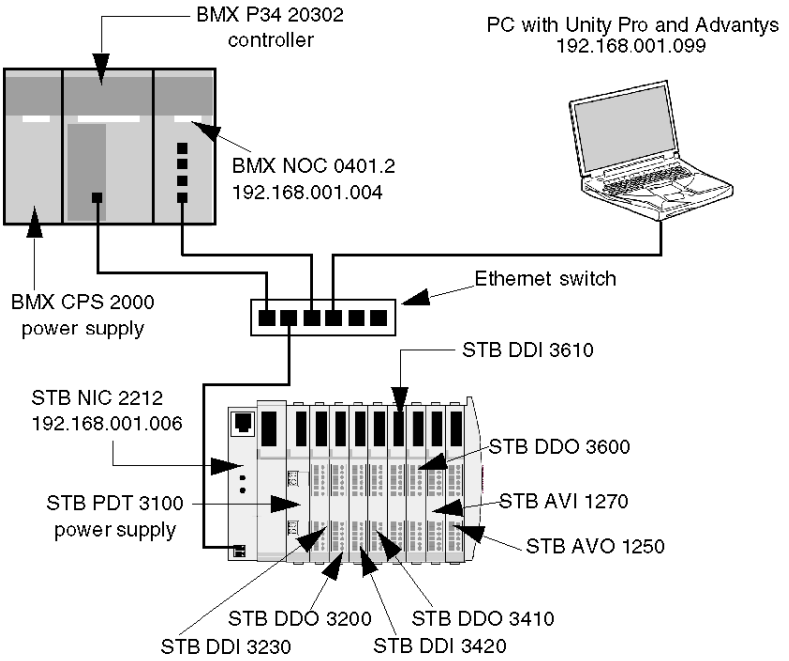
### Overview

This sample network includes the following hardware and software:

- a controller rack with:
  - BMX CPS 2000, 100/240 VAC power supply
  - BMX P34 20302 controller
  - BMX NOC 0401.2 Ethernet communication module
- a remote STB Advantys island with:
  - STB NIC 2212 EtherNet/IP network interface module
  - STB PDT 3100 power distribution module
  - STB DDI 3230 2 pt digital input module
  - STB DDO 3200 2 pt digital output module
  - STB DDI 3420 4 pt digital input module
  - STB DDO 3410 4 pt digital output module
  - STB DDI 3610 6 pt digital input module
  - STB DDO 3600 6 pt digital output module
  - STB AVI 1270 2 pt analog input module
  - STB AVO 1250 2 pt analog output module
- a PC running both Unity Pro (version 5.0 or higher) and Advantys configuration software (version 5.0 or higher)
- an Ethernet managed switch that is connected to the both the controller and island by means of twisted pair Ethernet cable and RJ45 connectors.

## Network Topology

The Ethernet network devices used in this configuration include the following:




To re-create this example:

- use the IP addresses for your own configuration's:
  - PC
  - BMX NOC 0401.2 Ethernet communication module
  - STB NIC 2212 network interface module
- check wiring

**NOTE:** Unity Pro software running in the PC is used to configure the BMX P34 20302 controller. In this example, the PC is indirectly wired to the CPU's Ethernet port via the Ethernet switch. Alternatively, you could bypass the switch and directly wire the PC to either the CPU's Modbus or USB ports.

# Adding an STB NIC 2212 Remote Device

## Overview

You can use the Unity Pro device library to add a remote device—in this example the STB NIC 2212 module—to your project. Only a remote device that is part of your Unity Pro device library can be added to your project. Refer to the topic describing the Add EDS File Wizard *(see page 118)* for instructions on how to add a device EDS file to the device library.

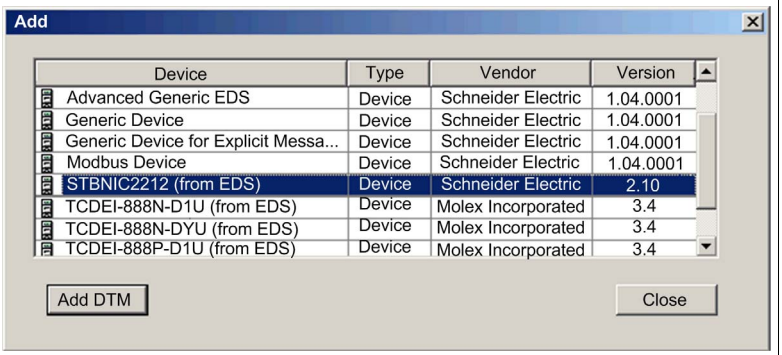
Alternatively, with a remote device already added to your device library, you can use automatic device discovery to populate your project. Perform automatic device discovery by using the **Field bus discovery** command with a communication module selected in the **DTM Browser**.

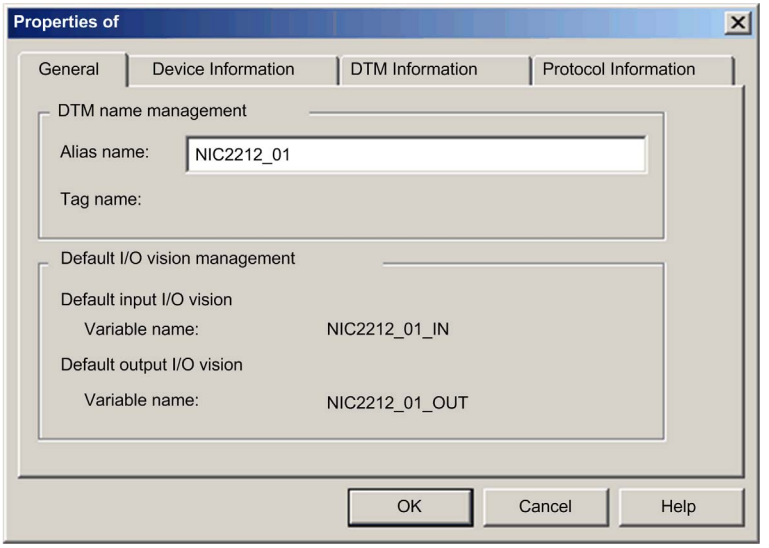
In either case, you need to update the list of available modules and devices, as follows:

| Step | Action |
|---|---|
| 1 | In the Unity Pro main menu, select **Tools** →**Hardware Catalog** to display that window. |
| 2 | In the **Hardware Catalog** window, click on the **DTM Catalog** tab to open that page. |
| 2 | In the **DTM Catalog** page, click **Reload catalog**. The list of available devices, as displayed both in the **DTM Catalog** page and the **Add** dialog, is updated and reflects any device additions or deletions. |

## Adding an STB NIC 2212 Remote Device

To add the STB NIC 2212 to your project, follow these steps:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select the Ethernet communication module node, and then click the right mouse button. A pop-up menu opens. |
| 2 | In the pop-up menu, select **Add...** The following dialog opens:  |

| Step | Action |
|---|---|
| 3 | In the **Add** dialog, select the **STBNIC2212**, then click **Add DTM**. The **Properties** window for the STB NIC 2212 network interface module opens. |
| 4 | In the **General** page of the **Properties** window, edit the default **Alias name**, because retaining the original default name can result in duplicate module names. In this example, type in the name **NIC2212_01**:<br>  <br><br>When you edit the **Alias name**, Unity Pro applies it as the base for both structure and variable names.<br>**NOTE:** No additional editing needs to be performed in the pages of this window. Except for the **Alias name** field, parameters are read-only. |
| 5 | Click **OK**. Unity Pro adds the new STB NIC 2212 network interface module to the **DTM Browser**, beneath the communication module. |
| 6 | Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to save your configuration edits. |

The next step is to configure the device you have just added to the project.

# Configuring STB NIC 2212 Properties

## Overview

Use the pages of the **Device Editor** to view and edit settings for a remote device. Before you can edit the device settings, disconnect the DTM from the remote device *(see page 46)*.

To display the DTM settings for a remote device, select the device name, which is found under the **Device List** node in the left pane of the **Device Editor**.

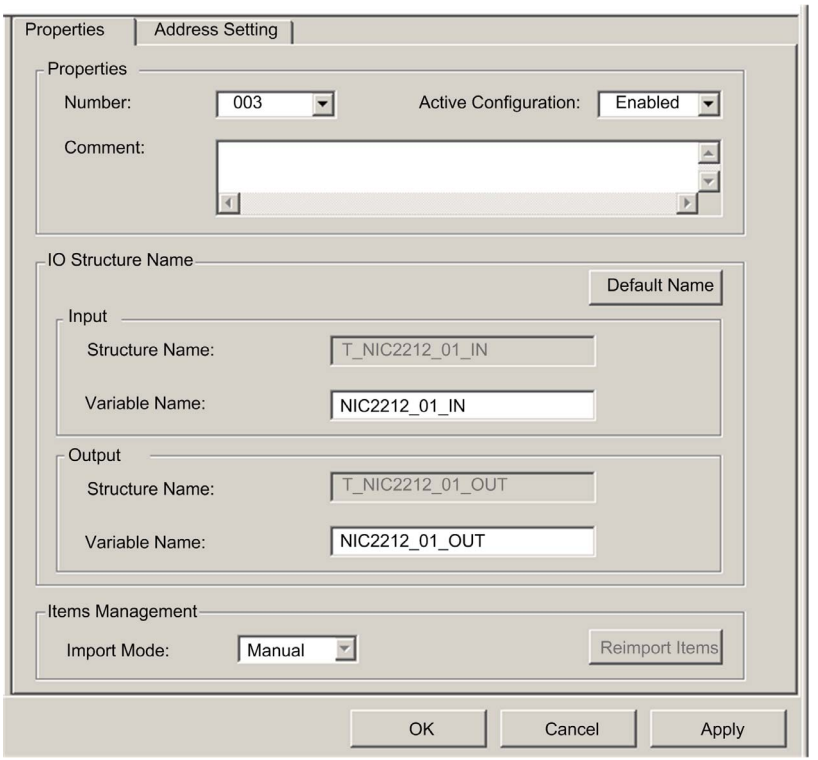
For the purposes of this example, which configures an STB NIC 2212 network interface module, select the node named **NIC2212 01**. The **Device Editor** displays the following pages:

- Properties
- Address Setting

**NOTE:** Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to edit properties.

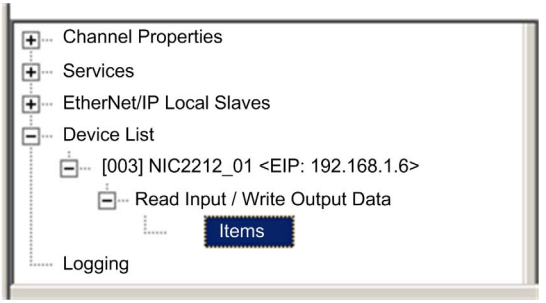
## Configuring the Properties Page

The **Properties** page for an STB NIC 2212 network interface module looks like this:



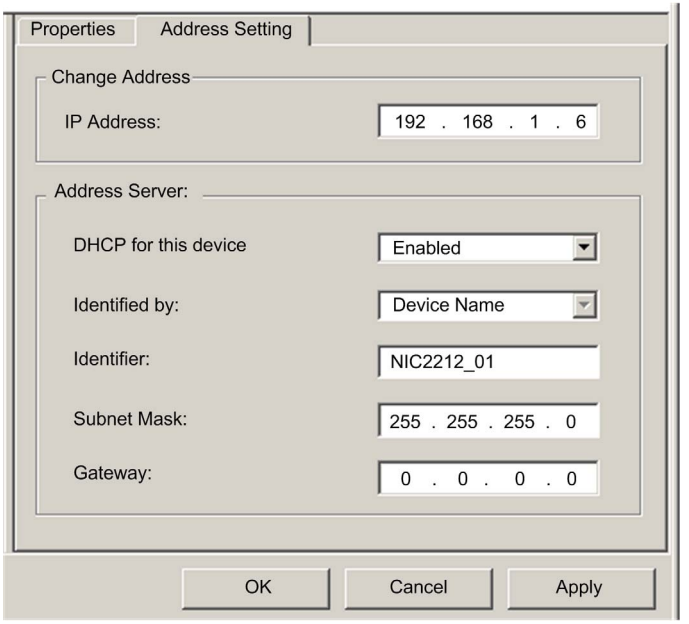
The following settings are used in this sample configuration. Use settings that are appropriate for your actual application:

| Step | Action | |
|---|---|---|
| 1 | In the **Properties** section of the page, edit the following: | |
| | Number | The relative position of the device in the list, from 0 to 127. For this example, accept the default of **003**. |
| | Active Configuration | • **Enabled:** adds this device to the Unity Pro project configuration<br>• **Disabled:** removes this device from the Unity Pro project configuration<br>Accept the default setting of **Enabled**. |
| 2 | In the **IO Structure Name** section of the page, edit the following: | |
| | Input area: | |
| | Structure Name | (Read-only) Unity Pro automatically assigns a structure name based on the variable name, in this case **T_NIC2212_01_IN**. |
| | Variable Name | Accept the auto-generated input variable name (based on the alias name *(see page 127)*): **NIC2212_01_IN**. |
| | Output area: | |
| | Structure Name | (Read-only) Unity Pro automatically assigns a structure name based on the variable name, in this case **T_NIC2212_01_OUT**. |
| | Variable Name | Accept the auto-generated output variable name (based on the alias name): **NIC2212_01_OUT**. |
| | Default Name button | Restores the default variable and structure names. For this example, custom names are used instead of the default names. |

| Step | Action | |
|---|---|---|
| 3 | In the Items Management section of the page, edit the following: | |
| | Import mode | • **Automatic:** Select this if I/O items are pre-defined for the device in its DTM, and will not subsequently be edited. These items are automatically created and added to the configuration, and later updated if the items list if the device DTM changes. These auto-created items cannot be edited in the **Device Editor**.<br>• **Manual:** Select this if I/O items will be manually created or edited. If the device DTM pre-defines I/O items, those pre-defined I/O items are automatically created and added to the configuration, and can later be manually edited in the **Device Editor**. The I/O items list is not affected by changes to the device DTM.<br>**NOTE:**<br>• Because the STB NIC 2212 DTM does not contain pre-configured input and output items, select **Manual**.<br>• To view I/O items, navigate to and select the **Items** node in the left pane of the **Device Editor**, as follows:<br>  |
| | Reimport Items | Imports the I/O items list from the device DTM, overwriting any manual I/O item edits. Enabled only when **Import mode** is set to **Manual**. |
| 4 | Click **Apply** to save your edits, and leave the window open for further edits. | |

## Configuring the Address Setting Page

Use the **Address Setting** page to enable the DHCP client in the STB NIC 2212 network interface module. When the DHCP client is enabled in the remote device, it will obtain its IP address from the DHCP server in the Ethernet communication module. The **Address Setting** page looks like this:



The following settings are used in this sample configuration. Use settings that are appropriate for your actual application:

| Step | Action | |
|---|---|---|
| 1 | In the **Address Settings** page, edit the following: | |
| | IP Address | By default:<br>● the first three octet values equal the first three octet values of the Ethernet communication module, and<br>● the fourth octet value equals this device Number setting—in this case, the default value would be 004.<br>In our continuing example, type in the address **192.168.1.6**. |
| | DHCP for this Device | ● **Enabled** activates the DHCP client in this device. The device obtains its IP address from the DHCP service provided by the Ethernet communication module and appears on the auto-generated DHCP client list *(see page 77)*.<br>● **Disabled** (the default) de-activates the DHCP client in this device.<br>Select **Enabled**. |
| | Identified by | If **DHCP for this Device** is **Enabled**, this indicates the device identifier type:<br>● **MAC Address**, or<br>● **Device Name**<br>Select **Device Name**. |
| | Identifier | If **DHCP for this Device** is **Enabled**, the specific device MAC Address or Name value.<br>Accept the default setting of **NIC2212_01** (based on the Alias name). |
| | Mask | The device subnet mask. The default = 255.255.255.0.<br>Accept the default value. |
| | Gateway | The gateway address used to reach this device. The default of 0.0.0.0 indicates this device is located on the same subnet as the Ethernet communication module.<br>Accept the default value. |
| 2 | Click **OK** to save your edits. | |

The next step is to configure the connection between the communication module and the remote device.

# Configuring EtherNet/IP Connections

## Overview

An EtherNet/IP connection provides a communication link between two or more devices. Properties for a single connection can be configured in the DTMs for the connected devices.

Use the **Device Editor** to view and edit connection settings. The following example presents settings for a connection between the BMX NOC 0401 communication module and a remote STB NIC 2212 network interface module. Configuration edits are made to the DTMs for each device.

When making DTM edits, disconnect the selected DTM from the actual module or device *(see page 46)*.

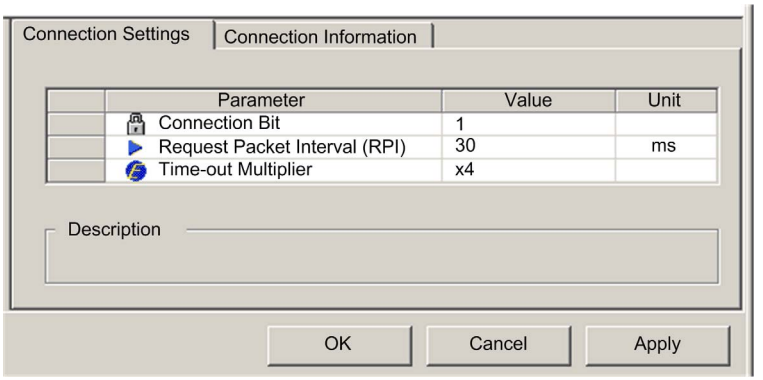
**NOTE:** Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to edit properties.

## Configuring Connection Settings in the Communication Module DTM

Unity Pro automatically creates a connection between a communication module and remote device, when the remote device is added to the Unity Pro project. Thereafter, many edits to the connection can be made in the DTM for the remote device. However, some of the connection parameters can also be configured in the DTM for the communication module, as demonstrated below.

The following connection settings for this sample configuration can be set in the DTM for the communication module. Use settings that are appropriate for your actual application:

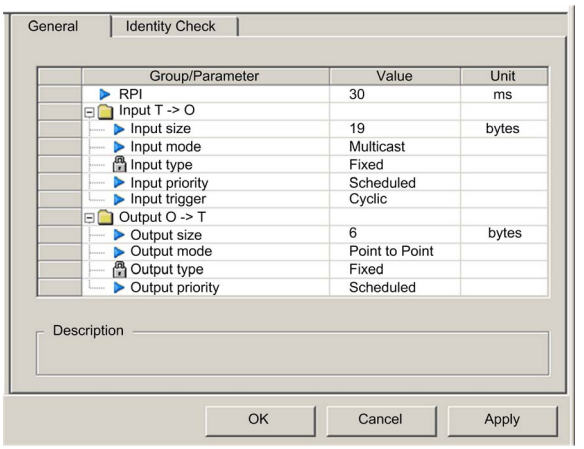
| Step | Action |
|---|---|
| 1 | Open the DTM for the communications module—in this example **NOC01**—by selecting it in the **Device Editor**, then do one of the following:<br>● in the main menu, select **Edit** →**Open**, or<br>● click the right mouse button, and select **Open** in the pop-up menu<br>The communication module DTM opens in the **Device Editor**. |
| 2 | In the navigation pane (on the left side of the **Device Editor**) select the node representing the connection from the communication module to the remote device, in this case:<br>**Device List** →**NIC2212_01** →**Read Input / Write Output Data** |

| Step | Action | |
|---|---|---|
| 3 | Click on the **Connection Settings** tab to open the following page:<br>  <br><br>**NOTE:** To view the **Time-out Multiplier** parameter, confirm that Unity Pro is operating in **Advanced Mode**. | |
| 4 | In the **Connection Settings** page, edit the following settings: | |
| | Connection Bit | (Read-only) The offset for both the health bit and the control bit for this connection. Offset values are auto-generated by the Unity Pro Ethernet Configuration Tool, beginning at 0, and are prioritized according to the connection type, as follows:<br>**1** Modbus TCP connections<br>**2** local slave connections<br>**3** EtherNet/IP connections<br>**NOTE:** The initial value of this EtherNet/IP connection is 1, because only a single local slave has previously been enabled. When a single Modbus TCP connection is created, the value of this connection bit offset changes to 2. |
| | Request Packet Interval (RPI) | The refresh period for this connection, from 2 to 65535 ms. Default = 12 ms. Type in **30** ms.<br>**NOTE:** This parameter can be set in the DTM for the communication module or the remote device. |
| | Time-out Multiplier | This setting, multiplied against the RPI, produces a value that triggers an inactivity timeout. Setting selections include: x4, x8, x16, x32, x64, x128, x256 and x512.<br>Accept the default of **x4**. |
| | **NOTE:** The Connection Information page is read-only when the communication module is selected. This information needs to be set in the DTM for the remote device. | |
| 5 | Click **OK** to save your settings. | |

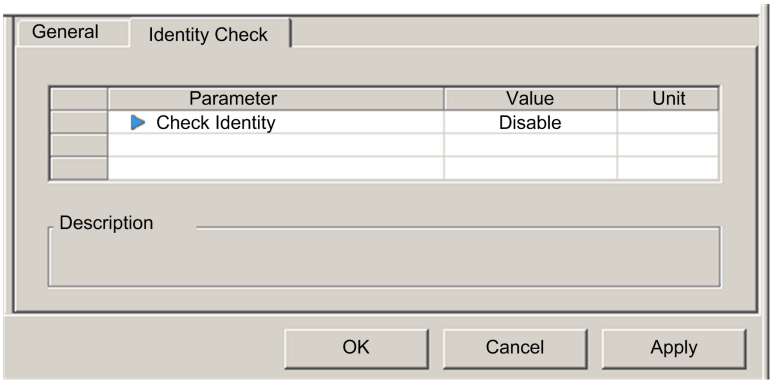
## Configuring Connection Settings in the Remote Device DTM

Connections between a communication module and remote device can be created and edited in the DTM for the remote device.

In this example, the following configuration edits are made to the connection that Unity Pro automatically created, when the remote device was added to the project. Use settings that are appropriate for your actual application:

| Step | Action | |
|---|---|---|
| 1 | Open the DTM for the remote device—in this example **NIC2212_01**—by selecting it in the **Device Editor**, then do one of the following:<br>● in the main menu, select **Edit** →**Open**, or<br>● click the right mouse button, and select **Open** in the pop-up menu<br>The remote device DTM opens in the **Device Editor**. | |
| 2 | In the navigation pane (on the left side of the **Device Editor**), confirm that the remote device connection is of the type **Read Input / Write Output Data**. To view the connection type, select **NIC2212_01** in the left pane of the **Device Editor**. If the connection type is not of the type **Read Input / Write Output Data**, delete the existing connection and add a new one, as follows: | |
| | a | With the connection selected in the left pane, click the **Remove Connection** button. The existing connection is removed. |
| | b | Click the **Add Connection** button. The **Select the connection to add** dialog opens. |
| | c | Use the scroll buttons on the drop down list to display and select the **Read Input / Write Output Data** connection type. |
| | d | Click **OK** to close the **Select the connection to add** dialog. The new connection node appears. |
| | e | Click **Apply** to save the new connection, leaving the **Device Editor** open for additional edits. |
| 3 | With the **Read Input / Write Output Data** node selected, click on the **General** tab:<br>  | |

| Step | Action | |
|---|---|---|
| 4 | In the **General** page, edit the following settings: | |
| | RPI | The refresh period for this connection. Accept the value of **30** ms. (This parameter can be set in the DTM for the communication module or the remote device.) |
| | Input size | The number of bytes reserved for input data, from 0 to 505. Type in **19**.<br>**NOTE:** Unity Pro reserves input data in increments of 4 bytes (2 words). In this example, typing in the value of 19 bytes reserve 20 bytes of input memory. |
| | Input mode | The transmission type:<br>● Multicast<br>● Point to Point<br>Accept the default selection of **Multicast**. |
| | Input type | Ethernet packet type—fixed or variable length—to be transmitted. Only **Fixed** length packets are supported. |
| | Input priority | The transmission priority. The value depends upon the device DTM. Values can include:<br>● Low<br>● High<br>● Scheduled<br>**NOTE:** For remote modules that support more than one priority value, you can use this setting to specify the order in which the Ethernet communication module will handle packets. For more information, refer to the topic describing QoS Packet Prioritization.<br>For the purpose of this example, accept the default selection of **Scheduled**. |
| | Input trigger | The transmission trigger. Values can include:<br>● Cyclic<br>● Change of state or application<br>For input I/O data, select **Cyclic**. |
| | Output size | The number of bytes reserved for output data, from  to 509. Type in **6**.<br>**NOTE:** Unity Pro reserves output data in increments of 4 bytes (2 words). In this example, typing in the value of 6 bytes reserves 8 bytes of output memory. |
| | Output mode | Accept the default selection of **Point to Point**. |
| | Output type | (Read-only). Only **Fixed** length packets are supported. |
| | Output priority | Accept the default selection of **Scheduled**. |

| Step | Action | |
|---|---|---|
| 5 | Click on the **Identity Check** tab to open the following page:<br>  | |
| 6 | In the **Identity Check** page, set rules for comparing the identity of the remote device, as defined by its DTM or EDS file, against the identity of the actual remote device located on the network. Complete the following settings: | |
| | Check Identity | Define the rule Unity Pro will use in comparing the configured versus the actual remote device. Settings include:<br>● **Must match exactly**—the DTM or EDS file exactly matches the remote device<br>● **Disable**—no checking occurs; the identity portion of the connection is filled with zero values (the default setting)<br>● **Must be compatible**—if the remote device is not the same as defined by the DTM/EDS, it emulates the DTM/EDS definitions<br>● **None**—no checking occurs; the identity portion of the connection is omitted<br>● **Custom**—enables the following 6 parameter settings, to be set individually.<br>For this example, select **Disable**. |
| | If **Check identity** is set to **Custom**, complete the following 6 fields: | |
| | Compatibility Mode | ● **True**—for each of the following selected tests, the DTM/EDS and remote device need only be compatible<br>● **False**—for each of the following selected tests, the DTM/EDS and remote device need to match exactly |
| | Minor Version | For each of the parameters to the left, select one of the following settings:<br>● **Compatible**—include the parameter in the test<br>● **Not checked**—the parameter is not included in the test |
| | Major Version | |
| | Product Code | |
| | Product Type | |
| | Product Vendor | |
| 7 | Click **OK** to save your settings. | |

The next step is to configure I/O settings.

# Connecting to the Advantys STB Island

## Overview

In this example, you will use the Advantys configuration software running on your PC to:

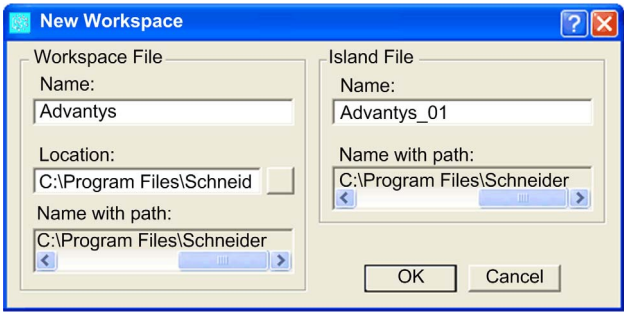
- connect the Advantys configuration software to the STB NIC 2212 and the 8 I/O modules that comprise the Advantys STB island
- upload Advantys STB island configuration to the Advantys configuration software in your PC
- display a fieldbus image for the Advantys STB island showing the relative location of:
  - status information
  - input data
  - output data

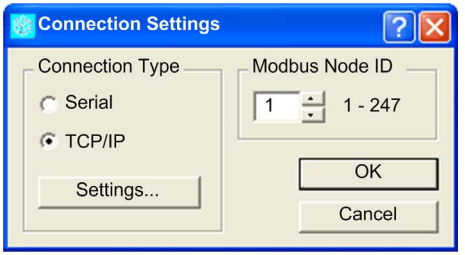
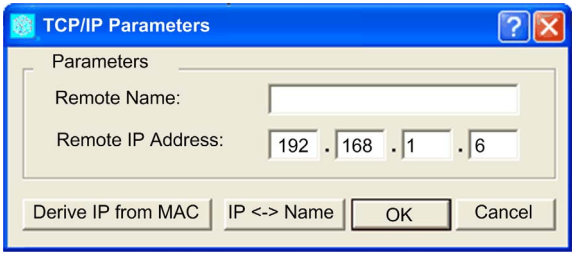
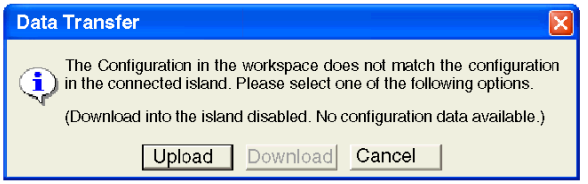
Using the data presented in the fieldbus image, you can use Unity Pro to create input and output items that map to specific status, input, output, and output echo data.

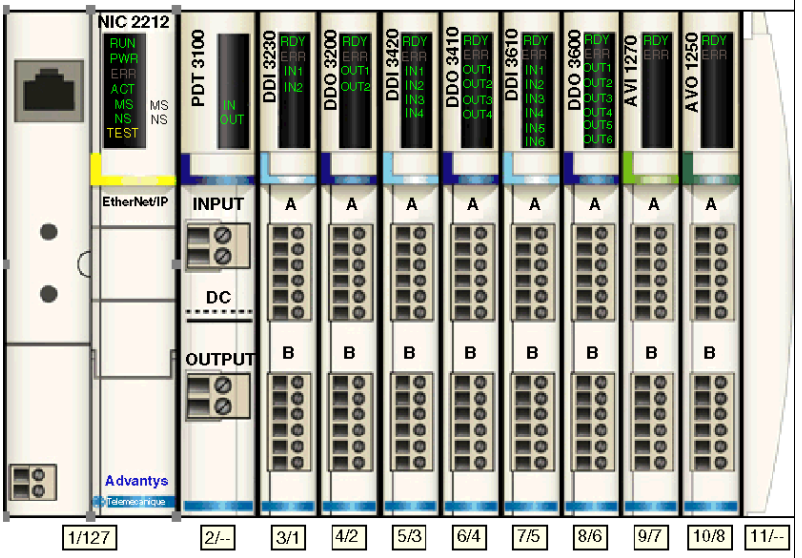
**NOTE:** Before proceeding with the following instructions, confirm that you have auto-configured the Advantys STB island by pressing the **RST** button on the front of the STB NIC 2212 module.

## Making the Connection

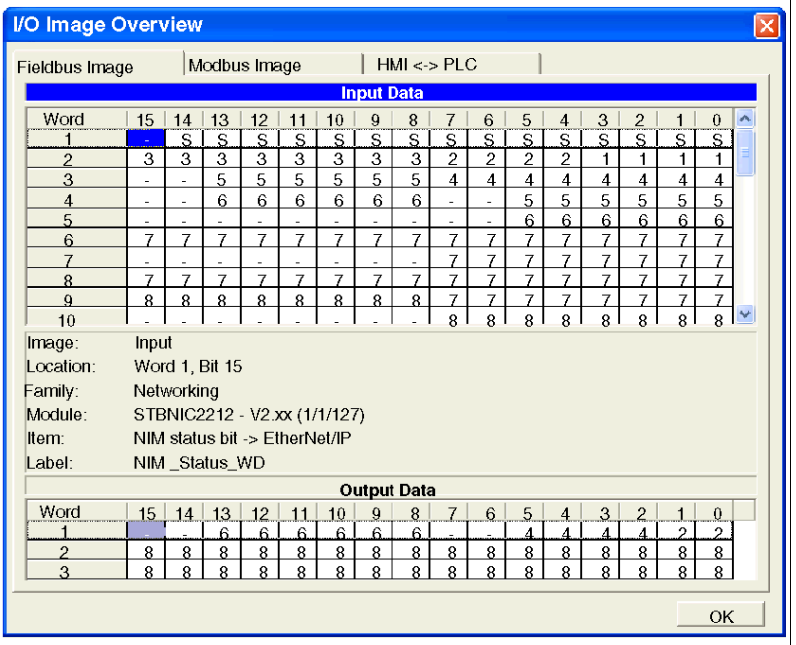
To connect to the STB NIC 2212 and I/O modules using the Advantys configuration software:

| Step | Action |
|---|---|
| 1 | Startup the Advantys configuration software on your PC. A dialog opens displaying available project types. |
| 2 | Select **STB**. |
| 3 | Select **File →New Workspace**. The **New Workspace** window opens (below). |
| 4 | For this example, type in the following field values:<br>● for the field **Workspace File** type in **Advantys**<br>● for the field **Island File** type in **Advantys_01**<br>  |
| 5 | Click **OK**. The Advantys configuration software displays an empty DIN rail in the center of the screen. |

| Step | Action |
|---|---|
| 6 | Select **Online** →**Connection Settings**. The **Connection Settings** window opens (below). |
| 7 | In the **Connection Settings** window, accept the **Modbus Node ID** default setting of **1**, select **TCP/IP**, and click the **Settings...** button:<br>  <br>The **TCP/IP Parameters** dialog opens (below). |
| 8 | In the **Remote IP Address** field, type in the IP address for the STB NIC 2212, in this example: **192.168.1.6**.<br>  |
| 9 | Click **OK** to close the **TCP/IP Parameters** dialog, and click **OK** again to close the **Connection Settings** dialog. |
| 10 | Select **Online** →**Connect**. The **Data Transfer** dialog opens (below):<br>  |

| Step | Action |
|---|---|
| 11 | Select **Upload** in the **Data Transfer** dialog. The island workspace is populated with island data and shows the STB NIC 2212 and the island modules (below):<br>  <br><br>**Note:** A box appears beneath each module containing one or two integers—for example 3/1. These integers serve the following purpose:<br>● The left-side integer (3 in this example) identifies the module's physical position—left to right—among the modules in the rack.<br>● The right-side integer (1 in this example) identifies the module's relative position—left to right—among only data producing/receiving modules. If the module is not a data producing/receiving module (e.g. a power supply, or end of segment module) no right-side integer appears. |

| Step | Action |
|---|---|
| 12 | Select **Island →I/O Image Overview**. The **I/O Image** window opens to the **Fieldbus Image** page: |




Each table cell contains one of the following alpha-numeric indicators:

- **S** indicates a status bit for the STB NIC 2212 network interface module
- **an integer** identifies the relative position—from left to right—of a data producing/receiving module with input or output data in that cell. For example:
  - the STB DDI 3230 input module is the first data producing or receiving module in the rack; its data is designated by the integer 1 in bits 0 - 3 of word 2 in the **Input Data** table
  - the STB DDO 3600 output module is the sixth data producing module in the rack; its status and output echo data is designated by the integer 6 in bits 8 - 13 of word 4 and in bits 0 - 5 of word 5 in the **Input Data** table; its output data is designated by the integer 6 in bits 8 - 13 of word 1 in the **Output Data** table

**Notes:**

Select a cell in either the **Input Data** or **Output Data** tables to display—in the middle of the page—a description of the cell data and its source module.

Convert the size of the **Input Data** table and the **Output Data** table from words to bytes (i.e. divide by 2), then use that data as the values for the **Input Size** (19) and **Output Size** (6) parameters when configuring the remote device's connection properties.

# Configuring I/O Items

## Overview

The final task in this example is to add I/O items to the configuration of the STB NIC 2212 and its 8 I/O modules. To accomplish this:

- use the Advantys configuration software to identify the relative position of each I/O module's inputs and outputs
- use the Unity Pro **Device Editor** to create input and output items, defining each item's:
  - name
  - data type

## I/O Item Types and Sizes

The goal is to create a collection of input items and output items that equal the input size and output size specified for the STB NIC 2212. In this example, items need to be created for:

- 19 bytes of inputs
- 6 bytes of outputs

The Unity Pro **Device Editor** provides great flexibility in creating input and output items. You can create input and output items in groups of 1 or more single bits, 8-bit bytes, 16-bit words, 32-bit dwords, or 32-bit IEEE floating values. The number of items you create depends upon the data type and size of each item.

In the sample project, the following items were created:

- discrete bits for digital inputs and outputs
- 8-bit bytes or 16-bit words for analog inputs and outputs

## Mapping Input and Output Items

Use the **Fieldbus Image** page of the **I/O Image Overview** window in the Advantys configuration software to identify the number and type of I/O items you need to create, as follows:

| Step | Action |
|---|---|
| 1 | In the Advantys configuration software, select **Island →I/O Image Overview**. The **I/O Image** window opens to the **Fieldbus Image** page. |
| 2 | Select the first cell (word 1, cell 0) in the **Input Data** table to display—in the middle of the page—a description of the cell data and its source module. |
| 3 | Make a note of the word, bit(s), module and item information for that cell. |
| 4 | Repeat steps 2 and 3 for each cell containing either an S or an integer. |

**NOTE:** The Fieldbus Image presents input and output data in the form of 16-bit words (starting with word 1). You need to rearrange this data for the Unity Pro Ethernet Configuration Tool, which presents the same data in the form of 8-bit bytes (starting with byte 0).

**NOTE:** When you create items, align items of data type `WORD` and `DWORD`, as follows:

- `WORD` items: align these items on a 16-bit boundary
- `DWORD` items: align these items on a 32-bit boundary.

This process yields the following tables of input and output data:

Input Data:

| Advantys Fieldbus Image | | Unity Pro EIP Items | | STB Module | Description |
|---|---|---|---|---|---|
| **Word** | **Bit(s)** | **Byte** | **Bit(s)** | | |
| 1 | 0-15 | 0 | 0-7 | NIC 2212 | low byte status |
| | | 1 | 0-7 | | high byte status |
| 2 | 0-1 | 2 | 0-1 | DDI 3230 | input data |
| | 2-3 | | 2-3 | DDI 3230 | input status |
| | 4-5 | | 4-5 | DDO 3200 | output data echo |
| | 6-7 | | 6-7 | DDO 3200 | output status |
| | 8-11 | 3 | 0-3 | DDI 3420 | input data |
| | 12-15 | | 4-7 | DDI 3420 | input status |
| 3 | 0-3 | 4 | 0-3 | DDO 3410 | output data echo |
| | 4-7 | | 4-7 | DDO 3410 | output status |
| | 8-13 | 5 | 0-5 | DDI 3610 | input data |
| | 14-15 | | 6-7 | NA | not used |
| 4 | 0-5 | 6 | 0-5 | DDI 3610 | input status |
| | 6-7 | | 6-7 | NA | not used |
| | 8-13 | 7 | 0-5 | DDO 3600 | output data echo |
| | 14-15 | | 6-7 | NA | not used |
| 5 | 0-5 | 8 | 0-5 | DDO 3600 | output status |
| | 6-15 | 8 | 6-7 | NA | not used |
| | | 9 | 0-7 | | |
| 6 | 0-15 | 10 | 0-7 | AVI 1270 | input data ch 1 |
| | | 11 | 0-7 | | |
| 7 | 0-7 | 12 | 0-7 | AVI 1270 | input status ch 1 |
| | 8-15 | 13 | 0-7 | NA | not used |
| 8 | 0-15 | 14 | 0-7 | AVI 1270 | input data ch 2 |
| | | 15 | 0-7 | | |
| 9 | 0-7 | 16 | 0-7 | AVI 1270 | input status ch 2 |
| | 8-15 | 17 | 0-7 | AVO 1250 | output status ch 1 |

| Advantys Fieldbus Image | | Unity Pro EIP Items | | STB Module | Description |
|---|---|---|---|---|---|
| Word | Bit(s) | Byte | Bit(s) | | |
| 10 | 0-7 | 18 | 0-7 | AVO 1250 | output status ch 2 |
| | 8-15 | NA | NA | NA | not used |

Output Data:

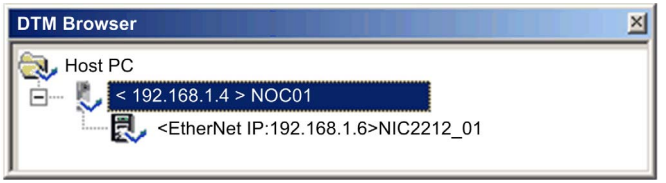
| Advantys Fieldbus Image | | Unity Pro EIP Items | | Module | Description |
|---|---|---|---|---|---|
| Word | Bit(s) | Byte | Bit(s) | | |
| 1 | 0-1 | 0 | 0-1 | DDO 3200 | output data |
| | 2-5 | | 2-5 | DDO 3410 | output data |
| | 6-7 | | 6-7 | NA | not used |
| | 8-13 | 1 | 0-5 | DDO 3600 | output data |
| | 14-15 | | 6-7 | NA | not used |
| 2 | 0-15 | 2 | 0-7 | AVO 1250 | output data ch 1 |
| | | 3 | 0-7 | | |
| 3 | 0-15 | 4 | 0-7 | AVO 1250 | output data ch 2 |
| | | 5 | 0-7 | | |

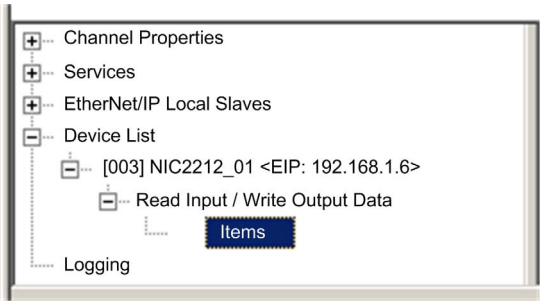
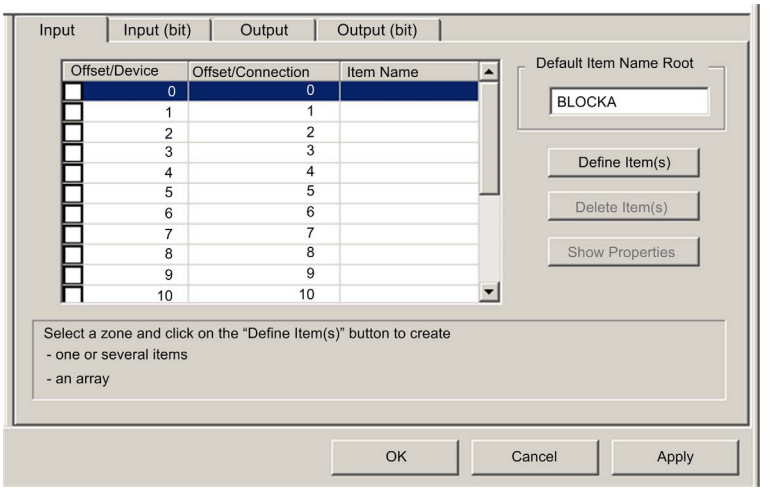
This example shows you how to create 19 bytes of inputs and 6 bytes of outputs. To more efficiently use space, this example creates items in the following sequence:

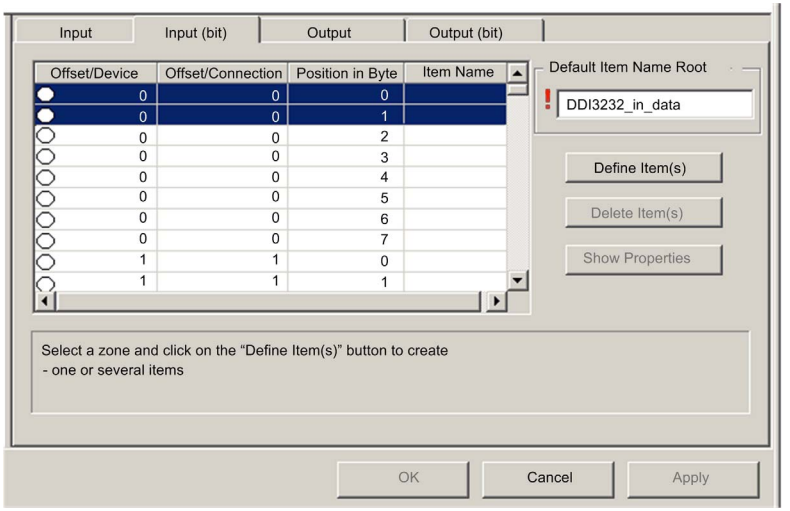
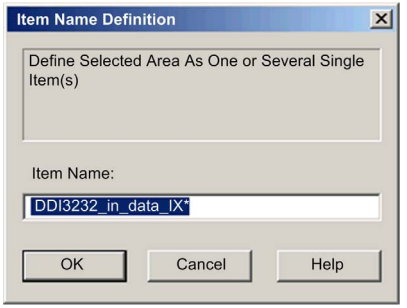
- input bit items
- input byte and word items
- output bit items
- output byte and word items

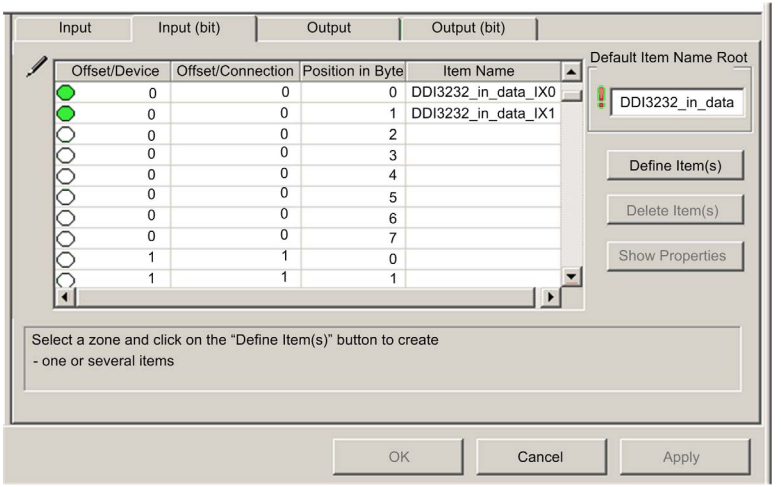
## Creating Input Bit Items

To create input bit items for the STB NIC 2212 example, beginning with 16 discrete inputs for NIC 2212 status:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select the communication module:<br>  |

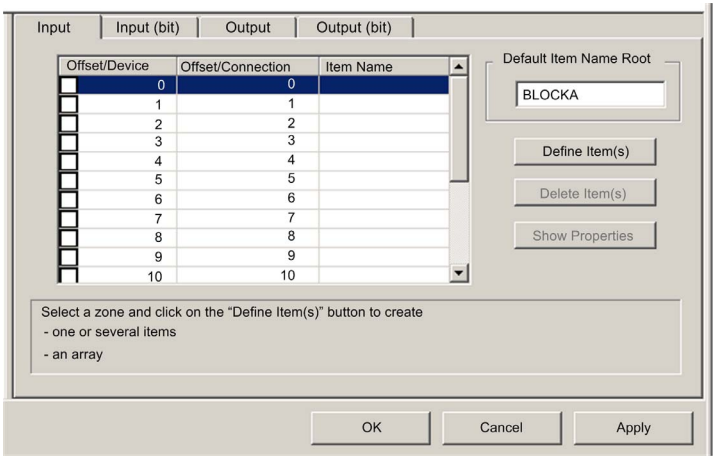
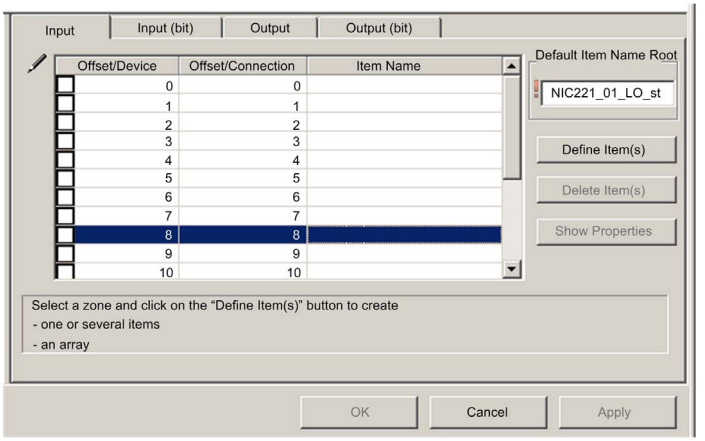
| Step | Action |
|---|---|
| 2 | Do one of the following:<br>● in the main menu, select **Edit** →**Open**, or<br>● click the right mouse button, then select **Open** in the pop-up menu.<br>The **Device Editor** opens, displaying the DTM for the communication module. |
| 3 | In the left pane of the **Device Editor**, navigate to and select the **Items** node for the STB NIC 2212 network interface module:<br>  |
| 4 | The **Items** window opens:<br>  |
| 5 | Select the **Input (bit)** tab to display that page. |
| 6 | In the **Input (bit)** page, type the following default root name—representing device status—into the **Default Items Name Root** input box type: **DDI3232_in_data**. |

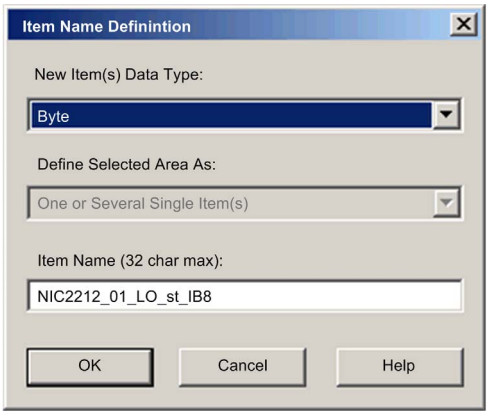
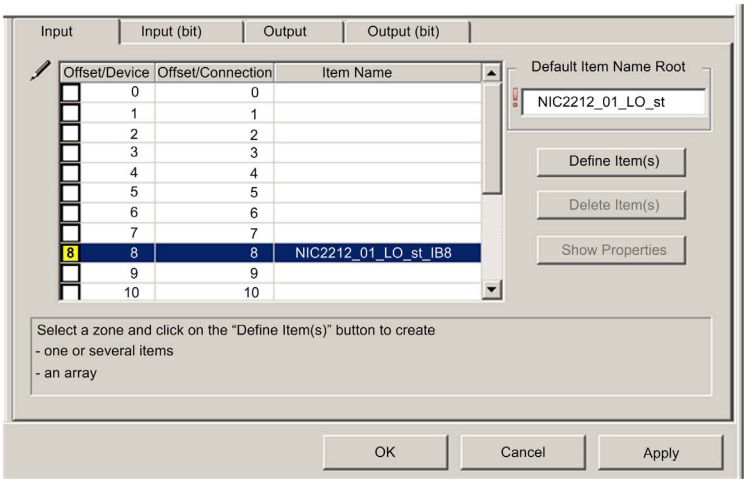
| Step | Action |
|---|---|
| 7 | In the **Items List**, select the first 2 rows in the table. (These rows represent bits 0-1 in byte.)<br>  |
| 8 | Click the **Define Item(s)** button. The **Item Name Definition** dialog opens:<br>  <br>**Note:** The asterisk (*) indicates a series of discrete items with the same root name will be created. |

| Step | Action |
|---|---|
| 9 | Accept the default **Item Name** and click **OK**. 2 discrete input items are created:<br>  |
| 10 | Click **Apply** to save the items, and leave the page open. |
| 11 | Repeat steps 6 - 10 for each group of discrete input items you need to create. In this example, that includes items for each of the following groups:<br>● Byte: 0, Bits: 2-3, Default Items Name Root: DDI3230_in_st<br>● Byte: 0, Bits: 4-5, Default Items Name Root: DDO3200_out_echo<br>● Byte: 0, Bits: 6-7, Default Items Name Root: DDO3200_out_st<br>● Byte: 1, Bits: 0-3, Default Items Name Root: DDI3420_in_data<br>● Byte: 1, Bits: 4-7, Default Items Name Root: DDI3420_in_st<br>● Byte: 2, Bits: 0-3, Default Items Name Root: DDO3410_out_echo<br>● Byte: 2, Bits: 4-7, Default Items Name Root: DDO3410_out_st<br>● Byte: 3, Bits: 0-5, Default Items Name Root: DDI3610_in_data<br>● Byte: 4, Bits: 0-5, Default Items Name Root: DDI3610_in_st<br>● Byte: 5, Bits: 0-5, Default Items Name Root: DDO3600_out_echo<br>● Byte: 6, Bits: 0-5, Default Items Name Root: DDO3600_out_st |
| 12 | The next task is to create input bytes and words. |

## Creating Input Items

To create input items for the STB NIC 2212 example, begin with an input data byte containing low byte status for the STB NIC 2212 module:

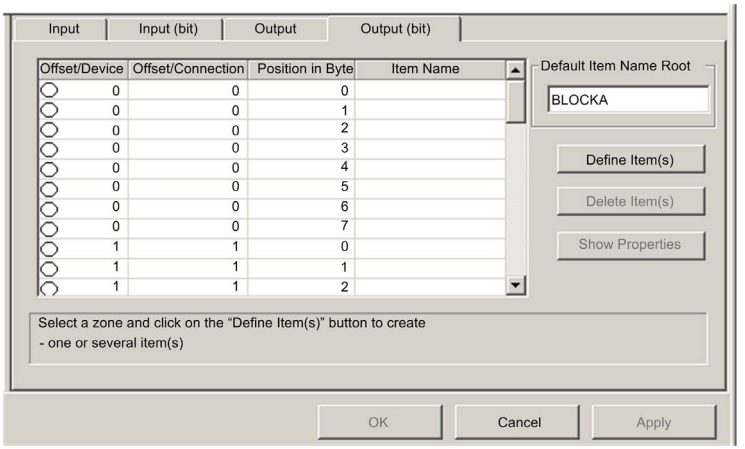
| Step | Action |
|---|---|
| 1 | Select the **Input** tab to return to that page:<br>  <br>**NOTE:** In this example, both the **Offset/Device** and **Offset/Connection** columns represent the byte address. The items you create will be either an 8-bit byte or a 16-bit word |
| 2 | In the **Default Item Name Root** input box type: **NIC22212_01_LO_st**. |
| 3 | Starting at the first available whole input word, select the single row at byte 8:<br>  |

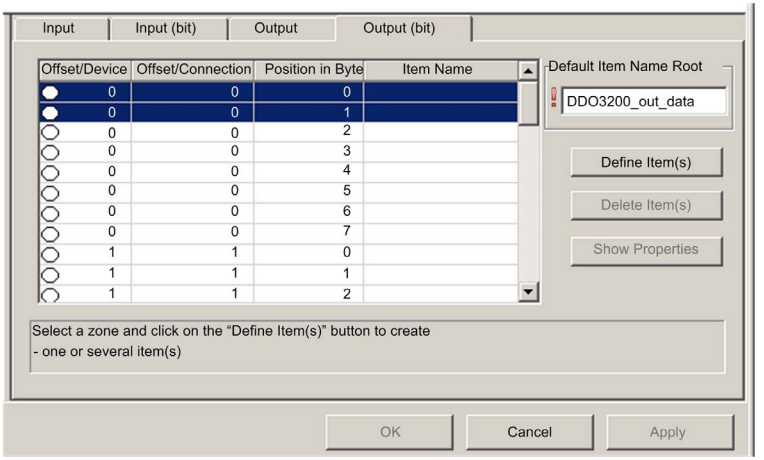
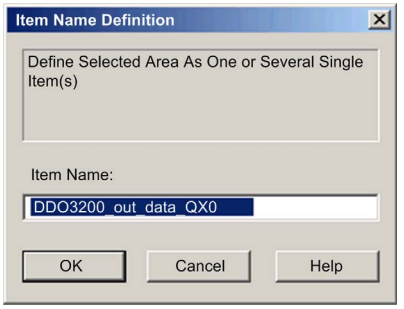
| Step | Action |
|---|---|
| 4 | Click the **Define Item(s)** button. The **Item Name Definition** dialog opens:<br>  |
| 5 | Select **Byte** as the **New Item(s) Data Type**, then click **OK**. A new byte item is created:<br>  |
| 6 | Click **Apply** to save the new items, and leave the page open. |

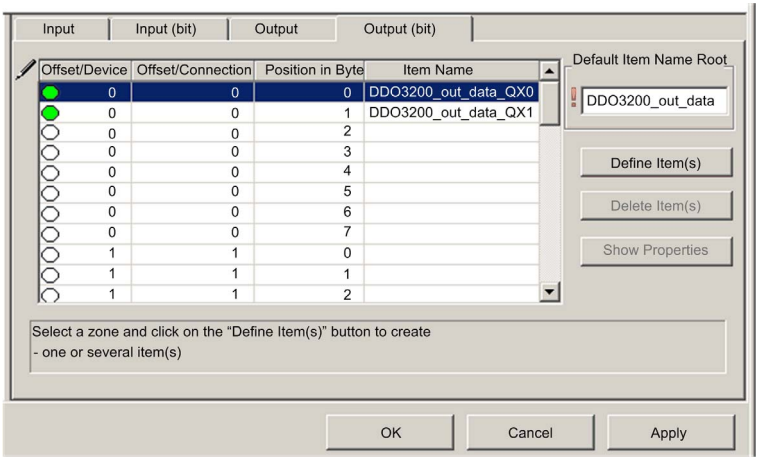
| Step | Action |
|---|---|
| 7 | Repeat steps 2 - 6 for each byte or word input item you need to create.<br>**NOTE:** The number of rows you select for a new item depends upon the item type. If the item is a:<br>● byte: select a single row<br>● word: select two rows, beginning at the next available whole word<br>In this example, you will create items for each of the following:<br>● Byte: 9, Default Items Name Root: NIC2212_01_HI_st<br>● Word: 10, Default Items Name Root: AVI1270_CH1_in_data<br>● Byte: 12, Default Items Name Root: AVI1270_CH1_in_st<br>● Word: 14-15, Default Items Name Root: AVI1270_CH2_in_data<br>● Byte: 16, Default Items Name Root: AVI1270_CH2_in_st<br>● Byte: 17, Default Items Name Root: AVO1250_CH1_out_st<br>● Byte: 18, Default Items Name Root: AVO1250_CH2_out_st |
| 8 | The next task is to create output bits. |

## Creating Output Bit Items

To create output bit items for the STB NIC 2212 example, beginning with 2 output bits for the STB DDO3200 module:

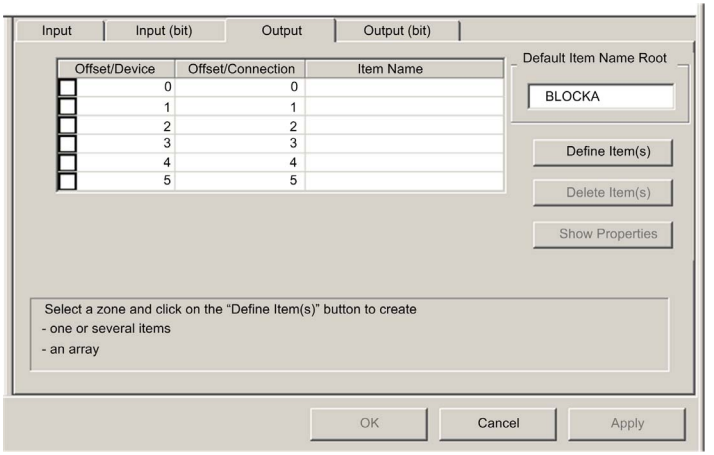
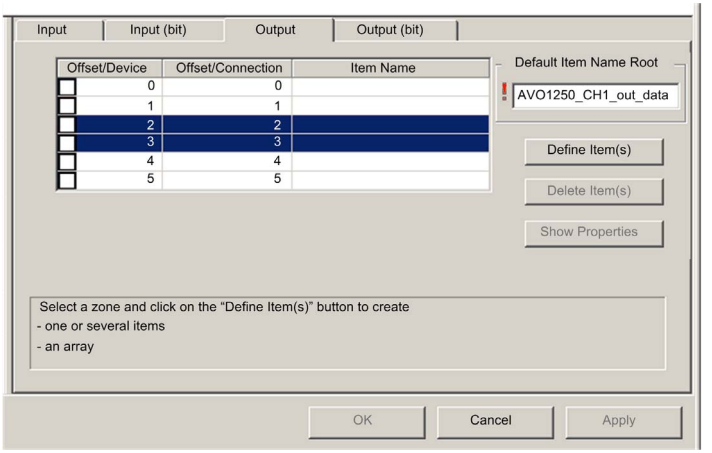
| Step | Action |
|---|---|
| 1 | Select the **Output (bit)** tab to open the following page:<br>  <br>**NOTE:** Both the **Offset/Device** and **Offset/Connection** columns represent the byte address of an output, while the **Position in Byte** column indicates the bit position—within the byte—of each discrete output item. |
| 2 | In the **Default Items Name Root** input box type: **DDO3200_out_data**. |

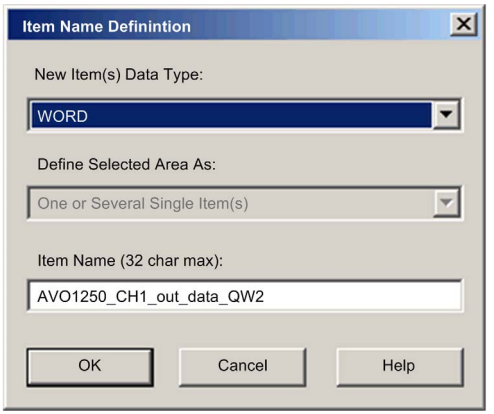
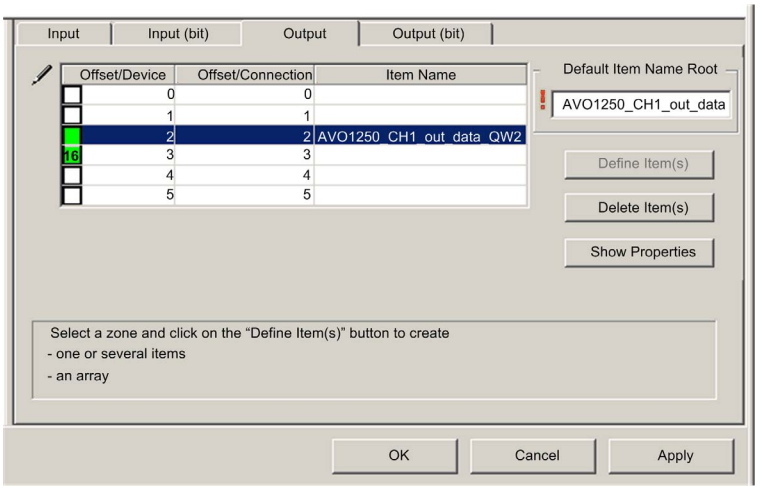
| Step | Action |
|---|---|
| 3 | In the **Items List**, select the rows that correspond to bits 0-1 in byte 0—i.e., the first 2 rows:<br>  |
| 4 | Click the **Define Item(s)** button. The **Item Name Definition** dialog opens:<br>  <br>**NOTE:** The asterisk (*) indicates a series of discrete items with the same root name will be created. |

| Step | Action |
|---|---|
| 5 | Accept the default output name and click **OK**. 2 discrete output items are created:<br>  |
| 6 | Click **Apply** to save the new items, and leave the page open. |
| 7 | Repeat steps 2 - 6 for each group of discrete output items you need to create. In this example, that includes items for each of the following groups:<br>● Byte: 0, Bits: 2-5, Default Items Name Root: DDO3410_out_data<br>● Byte: 1, Bits: 0-5, Default Items Name Root: DDO3600_out_data |
| 8 | The next task is to create output bytes and words. |

## Creating Numeric Output Items

To create output items for the STB NIC 2212, example, beginning with an output data word for the STB AVO 1250 module:

| Step | Action |
|---|---|
| 1 | Click on the **Output** tab to open the following page:<br>  <br><br>**NOTE:** In this example, both the **Offset/Device** and **Offset/Connection** columns represent the byte address. The items you create will be 16-bit words comprising 2 bytes. |
| 2 | In the **Default Item Name Root** input box type: **AVO1250_CH1_out_data**. |
| 3 | Starting at the next available whole word, select 2 rows: 2 and 3:<br>  <br> |

| Step | Action |
|---|---|
| 4 | Click the **Define Item(s)** button. The **Item Name Definition** dialog opens:<br>  |
| 5 | Accept the default output name and click **OK**. the following output word item is created:<br>  |
| 6 | Click **Apply** to save the new item and leave the page open. |
| 7 | Repeat steps 2 - 6 for the AVO 1250 channel 2 output data at bytes 4 and 5. |
| 8 | Click **OK** to close the **Items** window. |
| 9 | Select **File** →**Save** to save your edits. |

# Section 3.3
## Adding a Modbus TCP Device to the Network

### Overview

This section extends the sample Unity Pro application, by describing how to:

- add an STB NIP 2212 Modbus TCP network interface module to your Unity Pro application
- configure the STB NIP 2212 module
- configure a Modbus TCP connection linking the BMX NOC 0401 communication module and the STB NIP 2212 network interface module

**NOTE:** The instructions in this chapter describe a single, specific device configuration example. Refer to the Unity Pro help files for additional information about alternative configuration choices.

### What Is in This Section?

This section contains the following topics:


| Topic | Page |
|---|---|
| Setting Up Your Network | 157 |
| Adding an STB NIP 2212 Remote Device | 159 |
| Configuring STB NIP 2212 Properties | 161 |
| Connecting to the Advantys STB Island | 167 |
| Configuring I/O Items | 171 |

## Setting Up Your Network

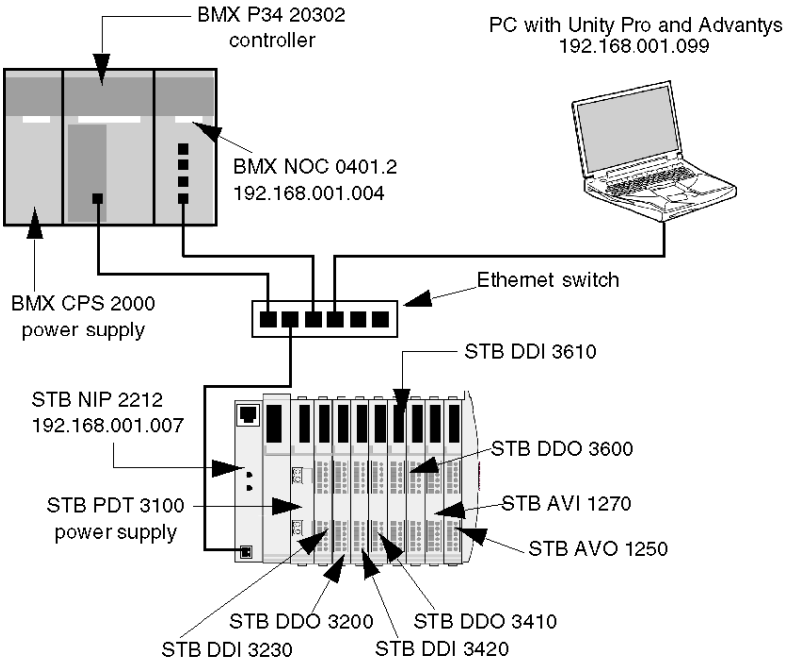
### Overview

This sample network includes the following hardware and software:

- a controller rack with:
  - BMX CPS 2000, 100/240 VAC power supply
  - BMX P34 20302 controller
  - BMX NOC 0401.2 Ethernet communication module
- a remote STB Advantys island with:
  - STB NIP 2212 Modbus TCP network interface module
  - STB PDT 3100 power distribution module
  - STB DDI 3230 2 pt digital input module
  - STB DDO 3200 2 pt digital output module
  - STB DDI 3420 4 pt digital input module
  - STB DDO 3410 4 pt digital output module
  - STB DDI 3610 6 pt digital input module
  - STB DDO 3600 6 pt digital output module
  - STB AVI 1270 2 pt analog input module
  - STB AVO 1250 2 pt analog output module
- a PC running both Unity Pro (version 5.0 or higher) and Advantys configuration software (version 5.0 or higher)
- an Ethernet managed switch that is connected to the both the controller and island by means of twisted pair Ethernet cable and RJ45 connectors.

## Network Topology

The Ethernet network devices used in this configuration include the following:




To re-create this example:

- use the IP addresses for your own configuration's:
  - PC
  - BMX NOC 0401.2 Ethernet communication module
  - STB NIP 2212 network interface module
- check wiring

**NOTE:** Unity Pro software running in the PC is used to configure the BMX P34 20302 controller. In this example, the PC is indirectly wired to the CPU's Ethernet port via the Ethernet switch. Alternatively, you could bypass the switch and directly wire the PC to either the CPU's Modbus or USB ports.

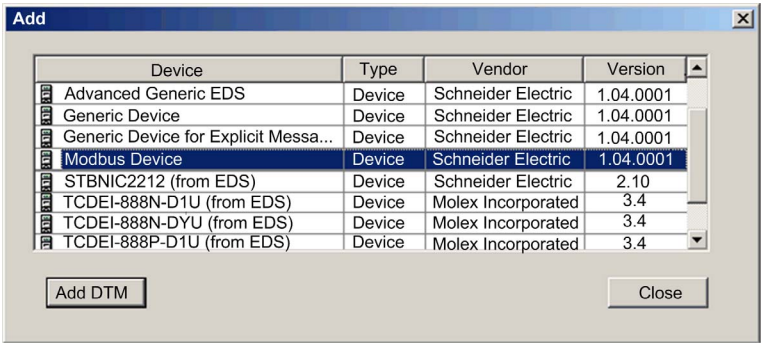
# Adding an STB NIP 2212 Remote Device

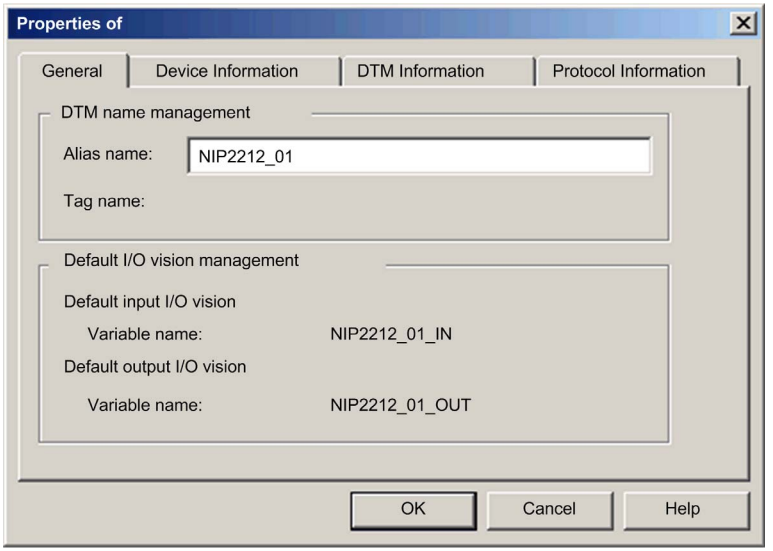
## Overview

Use the generic Modbus DTM selection, in the **Add** dialog, to select and insert an STB NIP 2212 module to your project.

## Adding an STB NIP 2212 Remote Device

To add the STB NIP 2212 to your project, follow these steps:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select the Ethernet communication module node, and then click the right mouse button. A pop-up menu opens. |
| 2 | In the menu, select **Add...** The following dialog opens:  |
| 3 | In the **Add** dialog, select the **STBNIP2212**, then click **Add DTM**. The **Properties** window for the STB NIP 2212 network interface module opens. |

| Step | Action |
|---|---|
| 4 | In the **General** page of the **Properties** window, edit the default **Alias name** to read **NIP2212_01**:<br>  <br><br>When you edit the **Alias name**, Unity Pro applies it as the base name for both structure and variable names.<br>**NOTE:** No additional editing needs to be performed in the pages of this window. Except for the **Alias name** field, parameters are read-only. |
| 5 | Click **OK**. Unity Pro adds the new STB NIP 2212 network interface module to the **DTM Browser**, beneath the communication module. |
| 6 | Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to save your configuration edits. |

The next step is to configure the device you have just added to the project.

# Configuring STB NIP 2212 Properties

## Overview

Use the pages of the **Device Editor** to view and edit settings for a remote device. To edit the device settings, disconnect the DTM from the remote device *(see page 46)*.

To display the DTM settings for a remote device, select the device name, which is found under the **Device List** node in the left pane of the **Device Editor**.

For the purposes of this example, which configures an STB NIP 2212 network interface module, select the node named **NIP2212_01**. The **Device Editor** displays the following pages:

- Properties
- Address Setting
- Request Setting

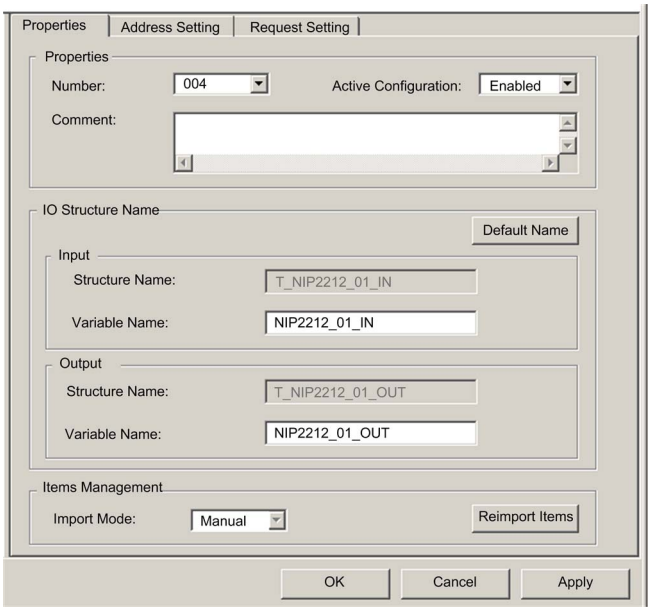
**NOTE:** Refer to the topic Configuring Properties in the Device Editor *(see page 54)* for instructions on how to edit properties.

## Configuring the Properties Page

Use the **Properties** page to:

- add the remote device to, or remove it from, the configuration
- edit the base name for variables and data structures used by the remote device
- indicate how input and output items will be created and edited

The **Properties** page for an STB NIP 2212 network interface module looks like this:



The following settings are used in this sample configuration. Use settings that are appropriate for your actual application:

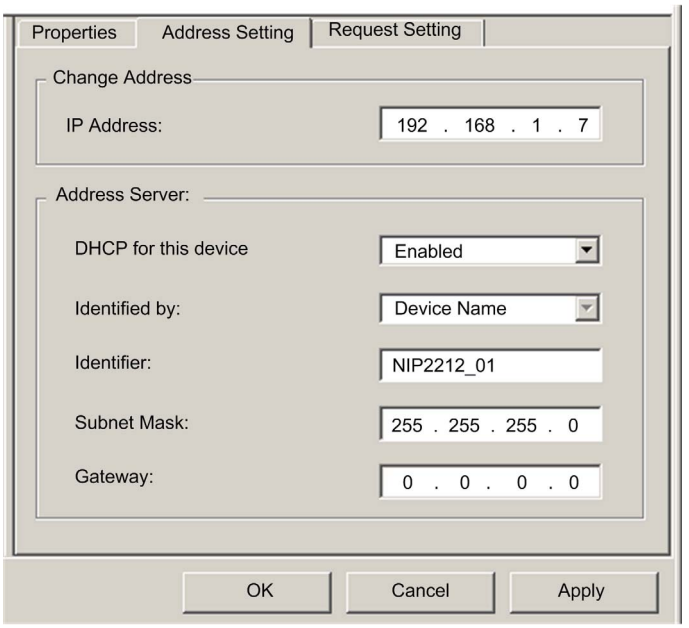
| Step | Action | |
|---|---|---|
| 1 | In the **Properties** section of the page, edit the following: | |
| | Number | The relative position of the device in the list, from 0...127.<br>For this example, accept the default of **004**. |
| | Active Configuration | • **Enabled:** adds this device to the Unity Pro project configuration<br>• **Disabled:** removes this device from the Unity Pro project configuration<br>Accept the default setting of **Enabled**. |
| 2 | In the **IO Structure Name** section of the page, edit the following: | |
| | Input area: | |
| | Structure Name | (Read-only) Unity Pro automatically assigns a structure name based on the variable name, in this case **T_NIP2212_01_IN**. |
| | Variable Name | Accept the auto-generated variable name (based on the alias name *(see page 159)*): **NIP2212_01_IN**. |
| | Output area: | |
| | Structure Name | (Read-only) Unity Pro automatically assigns a structure name based on the variable name, in this case **T_NIP2212_01_OUT**. |
| | Variable Name | Accept the auto-generated variable name (based on the alias name): **NIP2212_01_OUT**. |
| | Default Name button | Restores the default variable and structure names. For this example, custom names are used. |
| 3 | In the Items Management section of the page, edit the following: | |
| | Import mode | • **Automatic:** I/O items are taken from the device DTM and updated if the items list in the device DTM changes. Items cannot be edited in the **Device Editor**.<br>• **Manual:** I/O items are manually added in the **Device Editor**. The I/O items list is not affected by changes to the device DTM.<br>In this example, select **Manual**. |
| | Reimport Items | Imports the I/O items list from the device DTM, overwriting any manual I/O item edits. Enabled only when **Import mode** is set to **Manual**. |
| 4 | Click **Apply** to save your edits, and leave the window open for further edits. | |

## Configuring the Address Setting Page

Use the **Address Setting** page to:

- configure the IP address for the remote device
- enable, or disable, DHCP client software for the remote device

When the DHCP client software is enabled in the remote device, it will obtain its IP address from the DHCP server in the Ethernet communication module. The **Address Setting** page looks like this:



The following settings are used in this sample configuration. Use settings that are appropriate for your actual application:

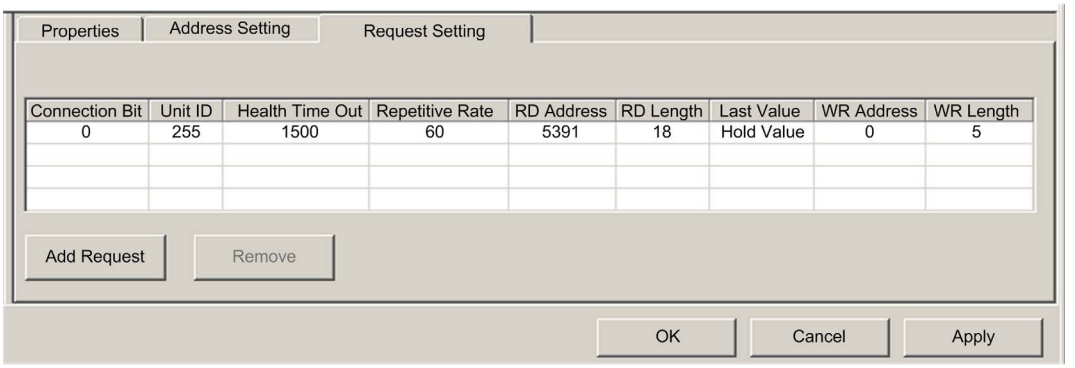
| Step | Action | |
|---|---|---|
| 1 | In the **Address Settings** page, edit the following: | |
| | IP Address | By default:<br>● the first three octet values equal the first three octet values of the Ethernet communication module, and<br>● the fourth octet value equals this device Number setting—in this case, 004.<br>In this example, the IP address is **192.169.1.7**. |
| | DHCP for this Device | ● **Enabled** activates the DHCP client in this device. The device obtains its IP address from the DHCP service provided by the Ethernet communication module and appears on the auto-generated DHCP client list *(see page 77)*.<br>● **Disabled** (the default) de-activates the DHCP client in this device.<br>Select **Enabled**. |
| | Identified by | If **DHCP for this Device** is **Enabled**, this indicates the device identifier type:<br>● **MAC Address**, or<br>● **Device Name**<br>Select **Device Name**. |
| | Identifier | If **DHCP for this Device** is **Enabled**, the specific device MAC Address or Name value.<br>Type in **NIP2212_01**. |
| | Mask | The device subnet mask. The default = 255.255.255.0.<br>Accept the default value. |
| | Gateway | The gateway address used to reach this device. The default of 0.0.0.0 indicates this device is located on the same subnet as the Ethernet communication module.<br>Accept the default value. |
| 2 | Click **Apply** to save your edits, and leave the window open for further edits. | |

The next step is to configure the connection between the communication module and the remote device.

## Configuring the Request Setting Page

Use the **Request Setting** page to add, configure, and remove Modbus requests for the remote device. Each request represents a separate link between the communication module and the remote device.

The **Request Setting** page for an STB NIP 2212 network interface module looks like this:




The **Add Request** function is enabled only when **Import Mode** is set to **Manual**.

The following settings are used in this sample configuration. Use settings that are appropriate for your actual application:

| Step | Action | |
|---|---|---|
| 1 | In the **Request Settings** page, edit the following: | |
| | Connection Bit | (Read-only) The offset for both the health bit and the control bit for this connection. Offset values are auto-generated by the Unity Pro Ethernet Configuration Tool—starting at 0—based on the connection type, in the following order:<br>1. Modbus TCP connections<br>2. Local Slave connections<br>3. EtherNet/IP connections<br>**NOTE:** When this Modbus TCP connection is created, the offset values for the previously created local slave and EtherNet/IP connections are incremented by 1: the local slave connection bit is set to 1, and the EtherNet/IP connection bit value is set to 2. |
| | Unit ID | The number of the device, or module, that is the target of the connection. A value of:<br>● 255 (the default) used to access the Ethernet communication module itself<br>● 254 causes no Modbus message to be sent; the module reports an event<br>● 0...253 identifies the device number of the target device, behind a Modbus TCP to Modbus gateway<br>**NOTE:** When accessing data in the Ethernet communication module itself, use 255. When accessing data in the application running in the PLC, use a value from 0 to 254 (a value of 1 is recommended).<br>Because the remote device itself is the request target, accept the default value of **255**. |
| | Health Timeout | The maximum allowed period, in milliseconds, between device responses, from 0...120000 ms in increments of 5 ms. When this setting is exceeded, the health timeout bit is set to 1. The default = 1500 ms. Accept the default value of **1500**. |
| | Repetitive Rate | The data scan rate, from 0...60000 ms, in intervals of 5 ms. The default = 60 ms. Accept the default value of **60**. |
| | RD Address | Address in the remote device of the input data image. The input data image begins at word 45391. Because there is an offset of 40000 in the M340 platform, type in a value of **5391**. |
| | RD Length | The number of words in the remote device, from 0...125, that the communication module will read. Because the Modbus device will be configured for 18 words of input items, type in a value of **18**. |
| | Last Value | The behavior of inputs in the application in the event communication is lost:<br>● Hold Value (the default)<br>● Set To Zero<br>Accept the default. |
| | WR Address | Address in the remote device of the output data image. The output data image begins at word 40000. Because there is an offset of 40000 in the M340 platform, type in a value of **0**. |
| | WR Length | The number of words in the remote device, from 0 to 120, to which the communication module will write. Because the Modbus device will be configured for 5 words of output items, type in a value of **5**. |
| 2 | Click **OK** to save your edits, and close the window. | |

The next step is to connect the Unity Pro project to the Advantys Island.

# Connecting to the Advantys STB Island

## Overview

In this example, you will use the Advantys configuration software running on your PC to:

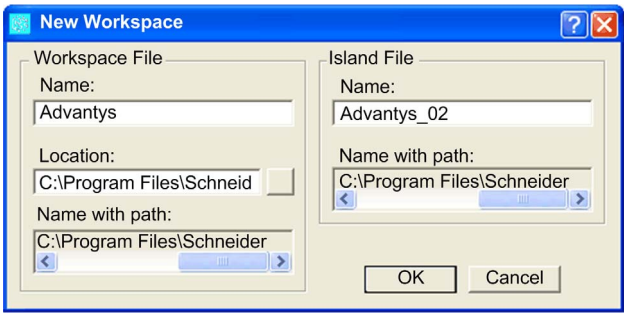
- connect the Advantys configuration software to the STB NIP 2212 and the 8 I/O modules that comprise the Advantys STB island
- upload Advantys STB island configuration to the Advantys configuration software in your PC
- display a fieldbus image for the Advantys STB island showing the relative location of:
  - input data
  - output data

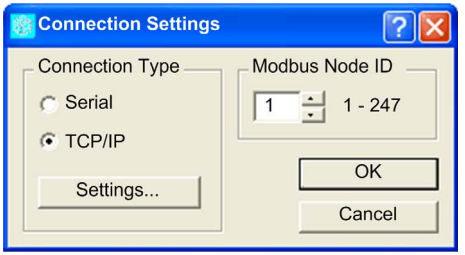
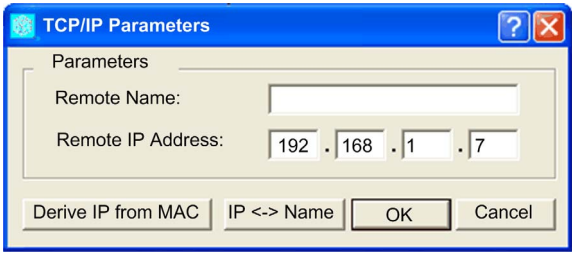
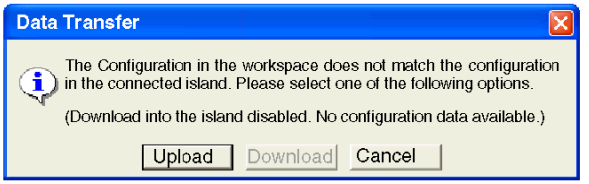
Using the data presented in the fieldbus image, you can use Unity Pro to create input and output items that map to specific input, output, and output echo data.

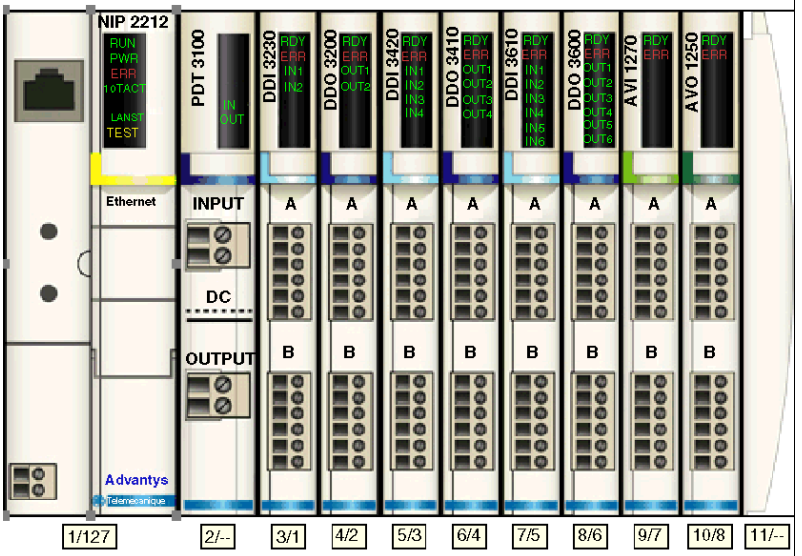
**NOTE:** Before proceeding with the following instructions, confirm that you have auto-configured the Advantys STB island by pressing the **RST** button on the front of the STB NIP 2212 module.

## Making the Connection

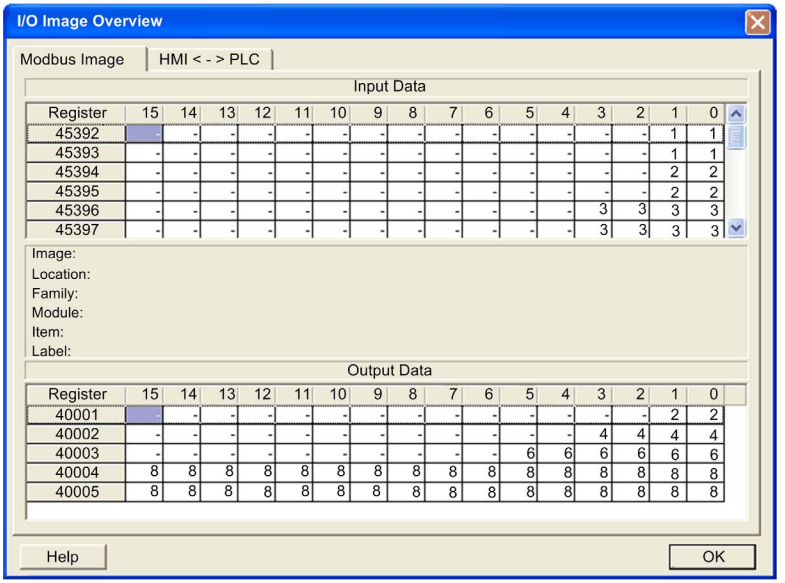
To connect to the STB NIP 2212 and I/O modules using the Advantys configuration software:

| Step | Action |
|---|---|
| 1 | Startup the Advantys configuration software on your PC. A dialog opens displaying available project types. |
| 2 | Select **STB**. |
| 3 | Select **File →New Workspace**. The **New Workspace** window opens (below). |
| 4 | For this example, type in the following field values:<br>● for the field **Workspace File** type in **Advantys**<br>● for the field **Island File** type in **Advantys_02**<br>  |
| 5 | Click **OK**. The Advantys configuration software displays an empty DIN rail in the center of the screen. |

| Step | Action |
|---|---|
| 6 | Select **Online** →**Connection Settings**. The **Connection Settings** window opens (below). |
| 7 | In the **Connection Settings** window, accept the **Modbus Node ID** default setting of **1**, select **TCP/IP**, and click the **Settings...** button:<br>  <br>The **TCP/IP Parameters** dialog opens (below). |
| 8 | In the **Remote IP Address** field, type in the IP address for the STB NIP 2212, in this example: **192.168.1.7**.<br>  |
| 9 | Click **OK** to close the **TCP/IP Parameters** dialog, and click **OK** again to close the **Connection Settings** dialog. |
| 10 | Select **Online** →**Connect**. The **Data Transfer** dialog opens (below):<br>  |

| Step | Action |
|---|---|
| 11 | Select **Upload** in the **Data Transfer** dialog. The island workspace is populated with island data and shows the STB NIP 2212 and the island modules (below):<br>  <br>**Note:** A box appears beneath each module containing one or two integers—for example 3/1. These integers serve the following purpose:<br>● The left-side integer (3 in this example) identifies the module's physical position—left to right—among the modules in the rack.<br>● The right-side integer (1 in this example) identifies the module's relative position—left to right—among only data producing/receiving modules. If the module is not a data producing/receiving module (e.g. a power supply, or end of segment module) no right-side integer appears. |

| Step | Action |
|---|---|
| 12 | Select **Island →I/O Image Overview**. The **I/O Image** window opens to the **Fieldbus Image** page: |




Each table cell contains an integer that identifies the relative rack position of a data producing/receiving module with input or output data in that cell. For example:

- the STB DDI 3230 input module is the first data producing or receiving module in the rack; its data and status information is indicated by the integer 1 in bits 0...1 of registers 45392 and 45393 in the **Input Data** table
- the STB DDO 3600 output module is the sixth data producing module in the rack; its output echo and status data is designated by the integer 6 in bits 0 - 5 of register 45402 and in bits 0 - 5 of register 45403 in the **Input Data** table; its output data is designated by the integer 6 in bits 0 - 5 of register 40003 in the **Output Data** table

**NOTE:**

- Select a cell in either the **Input Data** or **Output Data** tables to display—in the middle of the page—a description of the cell data and its source module.
- Convert the size of the **Input Data** table and the **Output Data** table from words to bytes (i.e. divide by 2), then use that information when setting the **RD Length** (inputs) and **WR Length** (outputs) parameters in the **Request Setting** page for the remote Modbus TCP device.

# Configuring I/O Items

## Overview

The next task in this example is to add I/O items to the configuration of the STB NIP 2212 and its 8 I/O modules. To accomplish this:

- use the **Modbus Image** page of the Advantys configuration software to identify the relative position of each I/O module's inputs and outputs
- use the Unity Pro **Device Editor** to create input and output items, defining each item's:
  - name
  - data type

**NOTE:** You can manually configure I/O items only when **Input Mode** is set to **Manual**.

## I/O Item Types and Sizes

Because the Modbus TCP network interface module transmits data in the form of 16-bit words, in this example you will create every input and output item using the **WORD** data type. This remains true even if the item contains only a few bits of data. Bit-packing is not permitted when, as in this example, the remote device is a Modbus TCP network interface module.

**NOTE:** When you add more devices to your network, it may be necessary to increase the size and index location of both inputs and outputs for your Unity Pro project *(see page 36)*.

In this example, the following number and type of items need to be created:

- 18 input words
- 5 output words

## Mapping Input and Output Items

Use the **Fieldbus Image** page of the **I/O Image Overview** window in the Advantys configuration software to identify the number and type of I/O items you need to create, as follows:

| Step | Action |
|---|---|
| 1 | In the Advantys configuration software, select **Island →I/O Image Overview**. The **I/O Image** window opens to the **Modbus Image** page. |
| 2 | Select the cell 0 of the first word (45392) in the **Input Data** table to display—in the middle of the page—a description of the cell data and its source module. |
| 3 | Make a note of the register number and item information for that word. |
| 4 | Repeat steps 2 and 3 for each word. |

**NOTE:** The Modbus Image presents input and output data in the form of 16-bit words (starting with word 1). You need to maintain this data format as you create input and output items in Unity Pro.

**NOTE:** When you create items, align items of data type `WORD` and `DWORD`, as follows:

- `WORD` items: align these items on a 16-bit boundary
- `DWORD` items: align these items on a 32-bit boundary

This process yields the following tables of input and output data:

Input Data (Read):

| Advantys Modbus Image | | Unity Pro Items | | STB Module | Description |
|---|---|---|---|---|---|
| Register | Bit(s) | Bytes | Bit(s) | | |
| 45392 | 0-1 | 0 | 0-1 | DDI 3230 | input data |
| | | 1 | not used | | |
| 45393 | 0-1 | 2 | 0-1 | DDI 3230 | input status |
| | | 3 | not used | | |
| 45394 | 0-1 | 4 | 0-1 | DDO 3200 | output data echo |
| | | 5 | not used | | |
| 45395 | 0-1 | 6 | 0-1 | DDO 3200 | output status |
| | | 7 | not used | | |
| 45396 | 0-3 | 8 | 0-3 | DDI 3420 | input data |
| | | 9 | not used | | |
| 45397 | 0-3 | 10 | 0-3 | DDI 3420 | input status |
| | | 11 | not used | | |
| 45398 | 0-3 | 12 | 0-3 | DDO 3410 | output data echo |
| | | 13 | not used | | |
| 45399 | 0-3 | 14 | 0-3 | DDO 3410 | output status |
| | | 15 | not used | | |
| 45400 | 0-5 | 16 | 0-5 | DDI 3610 | input data |
| | | 17 | not used | | |
| 45401 | 0-5 | 18 | 0-5 | DDI 3610 | input status |
| | | 19 | not used | | |
| 45402 | 0-5 | 20 | 0-5 | DDO 3600 | output data echo |
| | | 21 | not used | | |
| 45403 | 0-5 | 22 | 0-5 | DDO 3600 | output status |
| | | 23 | not used | | |
| 45404 | 0-15 | 24 | 0-7 | AVI 1270 | input data ch 1 |
| | | 25 | 0-7 | | |
| 45405 | 0-7 | 26 | 0-7 | AVI 1270 | input status ch 1 |
| | | 27 | not used | | |
| 45406 | 0-15 | 28 | 0-7 | AVI 1270 | input data ch 2 |
| | | 29 | 0-7 | | |

| Advantys Modbus Image | | Unity Pro Items | | STB Module | Description |
|---|---|---|---|---|---|
| Register | Bit(s) | Bytes | Bit(s) | | |
| 45407 | 0-7 | 30 | 0-7 | AVI 1270 | input status ch 2 |
| | | 31 | not used | | |
| 45408 | 0-7 | 32 | 0-7 | AVI 1270 | output status ch 1 |
| | | 33 | not used | | |
| 45409 | 0-7 | 34 | 0-7 | AVI 1270 | output status ch 2 |
| | | 35 | not used | | |

Output Data (Write):

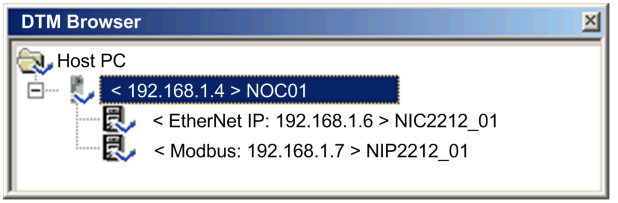
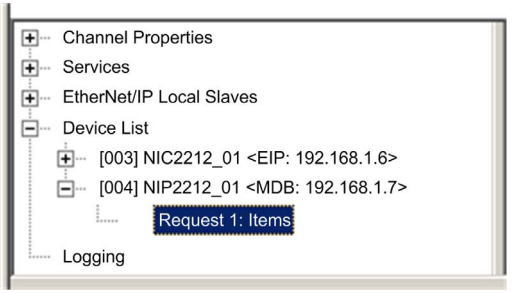
| Advantys Modbus Image | | Unity Pro Items | | STB Module | Description |
|---|---|---|---|---|---|
| Register | Bit(s) | Byte | Bit(s) | | |
| 40001 | 0-1 | 0 | 0-1 | DDO 3200 | output data |
| | | 1 | not used | | |
| 40002 | 0-3 | 2 | 0-3 | DDO 3410 | output data |
| | | 3 | not used | | |
| 40003 | 0-5 | 4 | 0-5 | DDO 3600 | output data |
| | | 5 | not used | | |
| 40004 | 0-15 | 6 | 0-7 | AVO 1250 | output data ch 1 |
| | | 7 | 0-7 | | |
| 40005 | 0-15 | 8 | 0-7 | AVO 1250 | output data ch 2 |
| | | 9 | 0-7 | | |

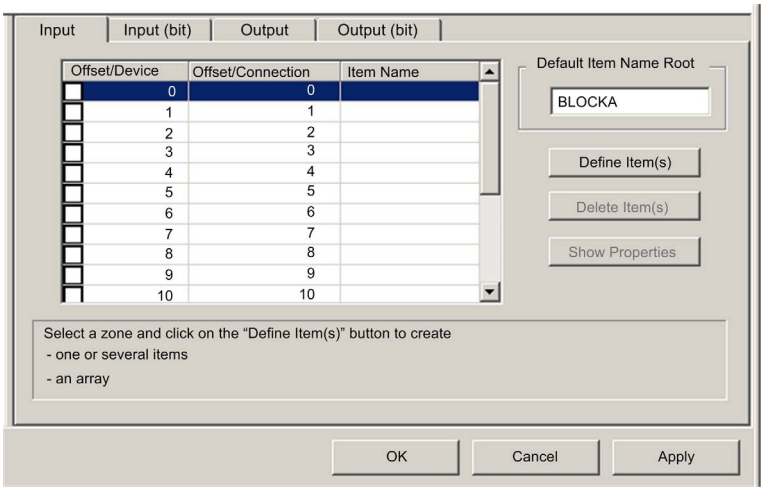
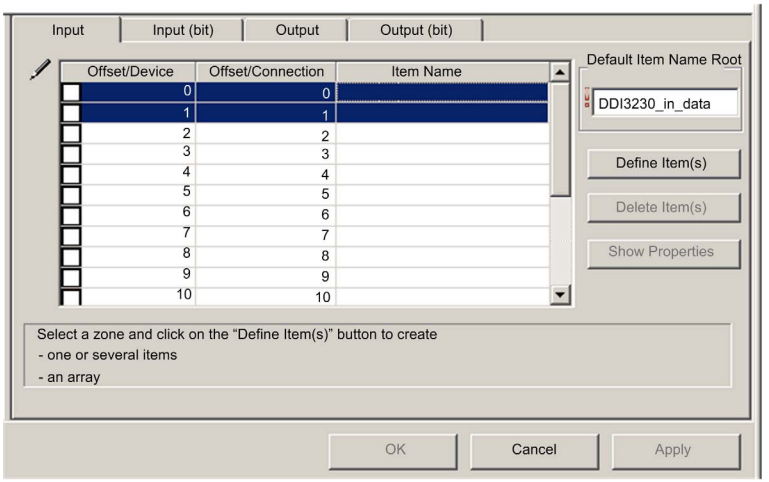
This example shows you how to create 18 words of inputs and 5 words of outputs. This example creates items in the following sequence:

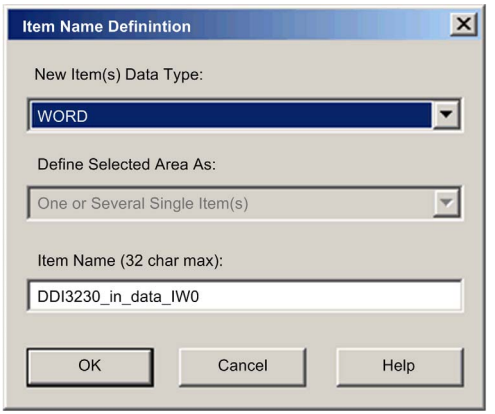
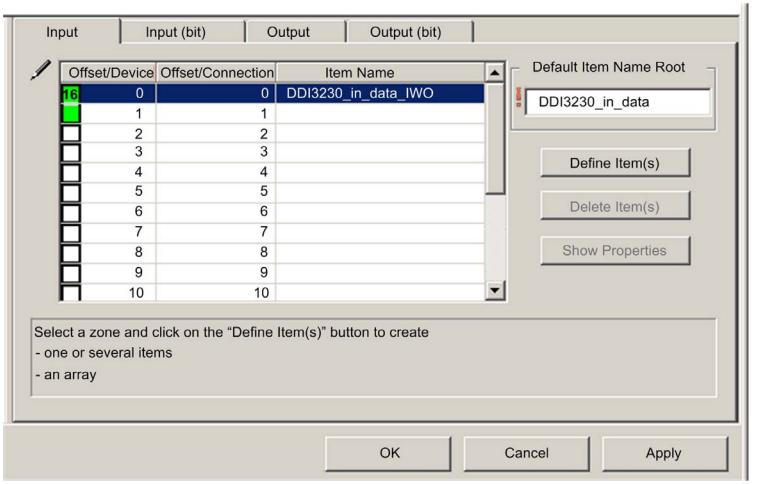
- input word items
- output word items

## Creating Input Word Items

To create input items for the STB NIP 2212 example, beginning with an input word for the DDI 3230 input module:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select the communication module:<br>  |
| 2 | Do one of the following:<br>● in the main menu, select **Edit** →**Open**, or<br>● click the right mouse button, then select **Open** in the pop-up menu.<br>The **Device Editor** opens, displaying the DTM for the communication module. |
| 3 | In the left pane of the **Device Editor**, navigate to and select the **Items** node for the STB NIP 2212 network interface module:<br>  |

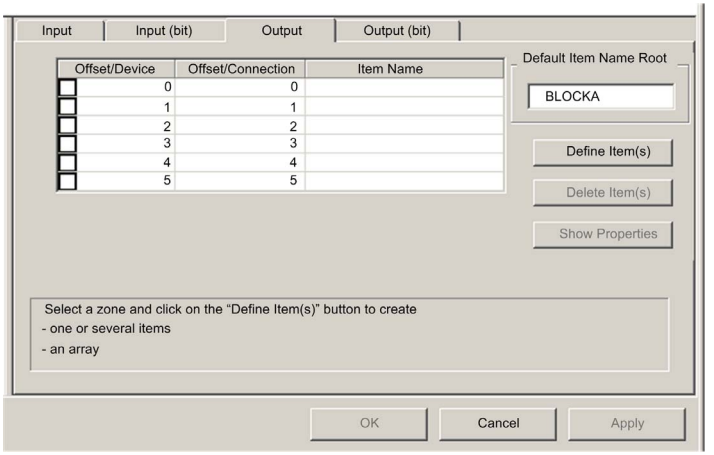
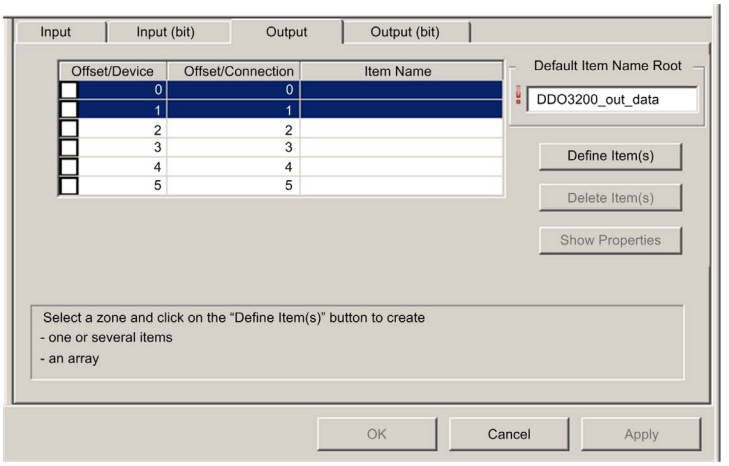
| Step | Action |
|---|---|
| 4 | Select the **Input** tab to open that page:<br>  <br><br>**NOTE:** In this example, each row represents a byte. Because the items you create will be a 16-bit word, each item consists of 2 rows. |
| 5 | In the **Default Item Name Root** input box type: **DDI3230_in_data**. |
| 6 | Starting at the beginning of the table, select the first two rows: 0 and 1:<br>  <br> |

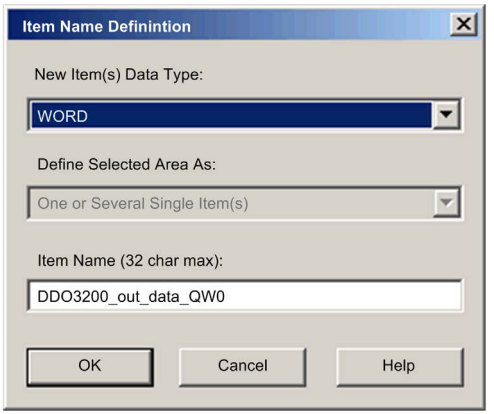
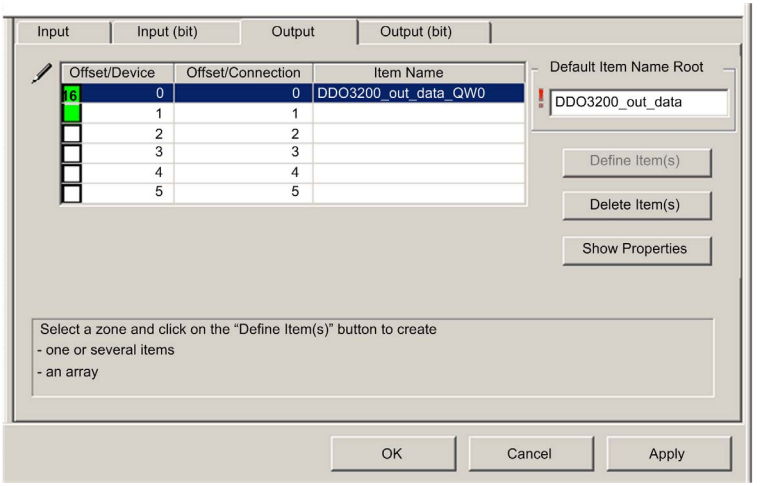
| Step | Action |
|---|---|
| 7 | Click the **Define Item(s)** button. The **Item Name Definition** dialog opens:<br>  <br>**NOTE:** The **Define Item(s)** button is enabled only when **Input Mode** is set to **Manual**. |
| 8 | Select **WORD** as the **New Item(s) Data Type**, then click **OK**. A new item is created:<br>  |
| 9 | Click **Apply** to save the new items, and leave the page open. |

| Step | Action |
|---|---|
| 10 | Repeat steps 2 - 6 for each new word item you need to create. In this example, that includes the following items:<br>● Rows 2-3, Default Items Name Root: DDI3230_in_st<br>● Rows 4-5: Default Items Name Root: DDO3200_out_echo<br>● Rows 6-7: Default Items Name Root: DDO3200_out_st<br>● Rows 8-9: Default Items Name Root: DDI3420_in_data<br>● Rows 10-11: Default Items Name Root: DDI3420_in_st<br>● Rows 12-13: Default Items Name Root: DDO3410_out_echo<br>● Rows 14-15: Default Items Name Root: DDO3410_out_st<br>● Rows 16-17: Default Items Name Root: DDI3610_in_data<br>● Rows 18-19: Default Items Name Root: DDI3610_in_st<br>● Rows 20-21: Default Items Name Root: DDO3600_out_echo<br>● Rows 22-23: Default Items Name Root: DDO3600_out_st<br>● Rows 24-25: Default Items Name Root: AVI1270_CH1_in_data<br>● Rows 26-27: Default Items Name Root: AVI1270_CH1_in_st<br>● Rows 28-29: Default Items Name Root: AVI1270_CH2_in_data<br>● Rows 30-31: Default Items Name Root: AVI1270_CH2_in_st<br>● Rows 32-33: Default Items Name Root: AVO1250_CH1_out_st<br>● Rows 34-35: Default Items Name Root: AVO1250_CH2_out_st |
| 11 | The next task is to create output words. |

## Creating Output Word Items

To create output items for the STB NIP 2212, example, beginning with an output data word for the DDO 3200 output module:

| Step | Action |
|---|---|
| 1 | Click on the **Output** tab to open the following page:<br>  <br><br>**NOTE:** In this example, each row represents a byte. Because the items you create will be a 16-bit word, each item consists of 2 rows. |
| 2 | In the **Default Item Name Root** input box type: **DDO3200_out_data**. |
| 3 | Starting at the beginning of the table, select the first 2 rows, 0 and 1:<br>  <br> |

| Step | Action |
|---|---|
| 4 | Click the **Define Item(s)** button. The **Item Name Definition** dialog opens:<br>  <br><br>**NOTE:** The **Define Item(s)** button is enabled only when **Input Mode** is set to **Manual**. |
| 5 | Select **WORD** as the **New Item(s) Data Type**, then click **OK**. A new item is created:<br>  <br> |
| 6 | Click **Apply** to save the new item and leave the page open. |

| Step | Action |
|---|---|
| 7 | Repeat steps 2 - 6 for each new word item you need to create. In this example, that includes the following items:<br>● Rows 2-3, Default Items Name Root: DDO3410_out_data<br>● Rows 4-5: Default Items Name Root: DDO3600_out_data<br>● Rows 6-7: Default Items Name Root: AVO1250_CH1_out_data<br>● Rows 8-9: Default Items Name Root: AVO1250_CH2_out_data |
| 8 | Click **OK** to close the **Items** window. |
| 9 | Select **File** →**Save** to save your edits. |

The next task is to update the Unity Pro application.

# Chapter 4
# Working With Derived Data Types

## Overview

This chapter describes how to complete your project by creating, updating, and viewing derived data type (DDT) variables in Unity Pro.

## What Is in This Chapter?

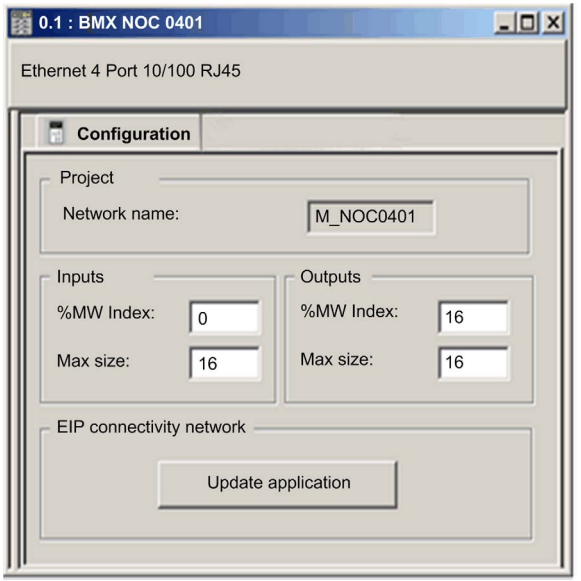
This chapter contains the following topics:

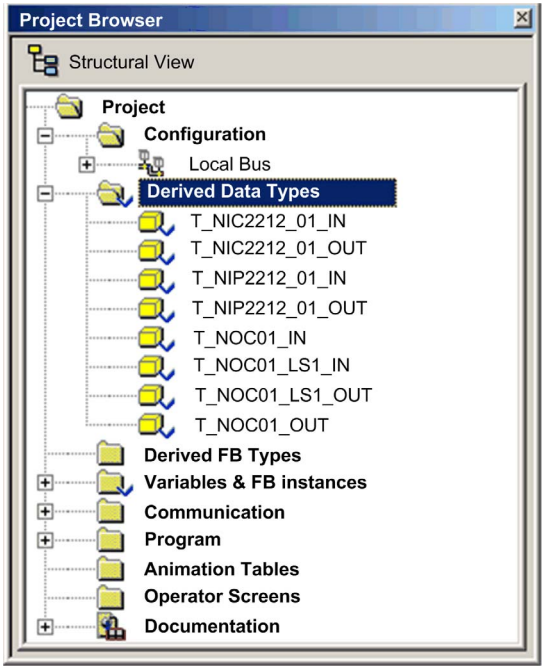

| Topic | Page |
|---|---|
| Creating and Updating Derived Data Types | 182 |
| Working with Derived Data Type Variables | 184 |
| Effect of Activating and De-activating Devices on I/O %MW Memory Addresses | 193 |

# Creating and Updating Derived Data Types

## Creating or Updating Derived Data Types

After you have completed your edits in the **Device Editor**, the next step is to let Unity Pro create the necessary program objects—in the form of derived data types (DDTs) and variables—that will support your network design. To do this, follow these steps:

| Step | Action |
|---|---|
| 1 | In the **Project Browser**, navigate to and select the communication module. |
| 2 | Do one of the following:<br>● click the right mouse button, and select **Open** in the pop-up menu, or<br>● in the **Edit** menu, select **Open**.<br>The **Configuration** page of the Ethernet communication module opens, below:<br>  |
| 3 | Click the **Update application** button.<br>**NOTE:**<br>● Every time you use the **Device Editor** to make changes to your Unity Pro project, return to this screen and click the **Update application** button to save your edits.<br>● Unity Pro refreshes the collection of DDTs and variables—by adding, editing, or deleting previously generated DDTs and variables—each time you:<br>  ● click on the **Update application** button, above, or<br>  ● select either **Build →Build Changes** or **Build →Rebuild All Project** |

| Step | Action |
|---|---|
| 4 | Click **OK**. The **Project Browser** displays the new or edited derived data types, below:  |

# Working with Derived Data Type Variables

## Derived Data Type Variables

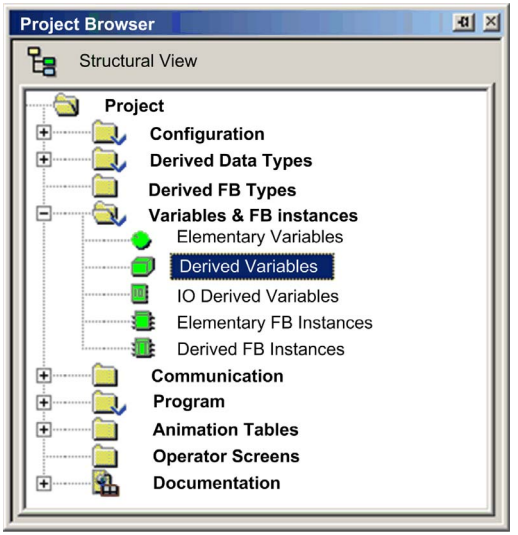
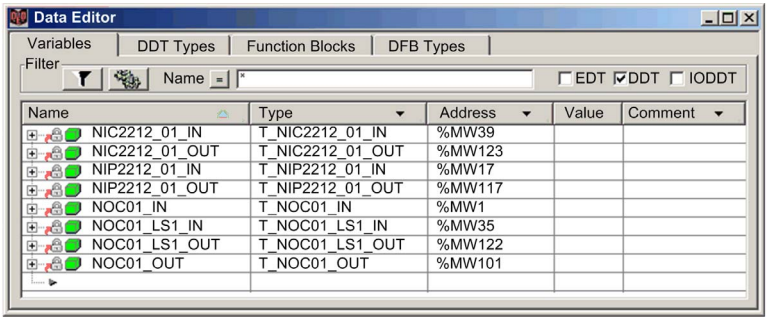
When you click on the **Update application** button, Unity Pro creates a collection of derived data types and variables. These are used by Unity Pro to support communication and data transfer between the PLC and the various local slaves, remote devices, and their I/O items. You can access these derived data types and variables in the Unity Pro **Data Editor** and add them to a user-defined **Animation Table**, where you can monitor read-only variables and edit read-write variables.

Use these data types and variables to:

- view the status of connections from the communication module to remote EtherNet/IP and Modbus TCP devices, where:
  - the status of connections is displayed in the form of a HEALTH_BITS array consisting of 32 bytes
  - each connection is represented by a single bit in the array
  - a bit value of 1 indicates the connection is healthy
  - a bit value of 0 indicates the connection is lost, or the communication module can no longer communicate with the remote device
- toggle a connection ON (1) or OFF (0) by writing to a selected bit in a 32 byte CONTROL_BITS array
  **NOTE:** Distinguish between toggling a bit in the CONTROL_BITS array on or off, and enabling or disabling a remote device.
- monitor the value of local slave and remote device input and output items you created in the Unity Pro **Device Editor**

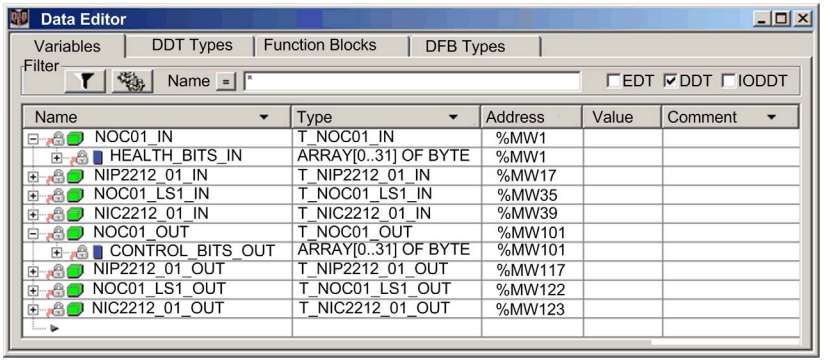
## Identifying Derived Variables in the Data Editor

To view your Unity Pro application's derived data type variables:

| Step | Description |
|---|---|
| 1 | In the **Project Browser**, navigate to and double-click the left mouse button on **Variables & FB instances** →**Derived Variables**:<br>  |
| 2 | The **Data Editor** opens, displaying the **Variables** page:<br>  <br>**NOTE:**<br>• A check mark appears in the **DDT** checkbox. (If not, select the **DDT** checkbox to display these variables.)<br>• The red arrow and lock icons indicate the variable name was auto-generated by Unity Pro based on the configuration of the local slave or remote device and cannot be edited. |

## Displaying the Order of Input and Output Items in PLC Memory

The **Data Editor** displays the address of each input and output variable. Click once on the **Address** column header to sort input and output addresses in ascending order. When you open the first input and output variables, you can see both the connection health bits and the connection control bits:




Note the order of inputs and outputs in the above example. Recall that the user defines the size and location of inputs and outputs *(see page 36)*. However, within the reserved area for both inputs and outputs, Unity Pro assigns addresses to variables in the following order:

| Inputs | Order | Outputs |
|---|---|---|
| Health bits [1] | 1 | Control bits [1] |
| Modbus TCP input variables [2] | 2 | Modbus TCP output variables [2] |
| Local Slave input variables [3] | 3 | Local Slave output variables [3] |
| EtherNet/IP input variables [2] | 4 | EtherNet/IP output variables [2] |

**1.** Health and control bits are sub-ordered as follows:
- **i.** by device type: a. Modbus TCP; b. local slave; c. EtherNet/IP
- **ii.** within each device type:
  - a. by device or local slave number
  - b. within a device: by connection number

**2.** Device variables are sub-ordered as follows:
- **i.** by device number
- **ii.** within a device: by connection number
- **iii.** within a connection: by item offset

**3.** Local slave variables are sub-ordered as follows:
- **i.** by local slave number
- **ii.** within each local slave: by item offset

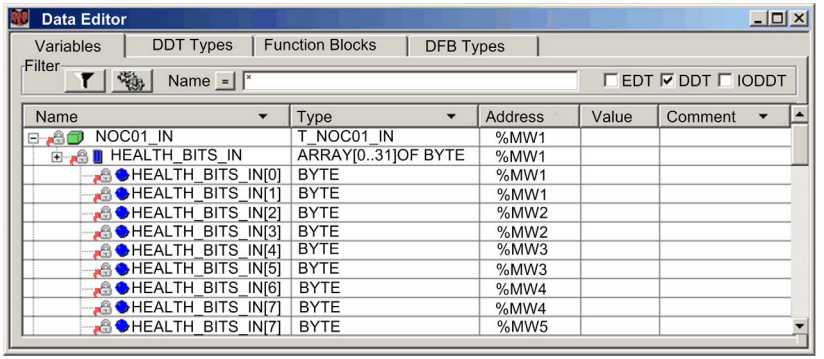
**NOTE:** When a device is added to or removed from the project, or when the active status of an existing device or a local slave changes, the specific location of inputs and outputs in PLC memory also changes.

## Identifying the Connection Health Bits

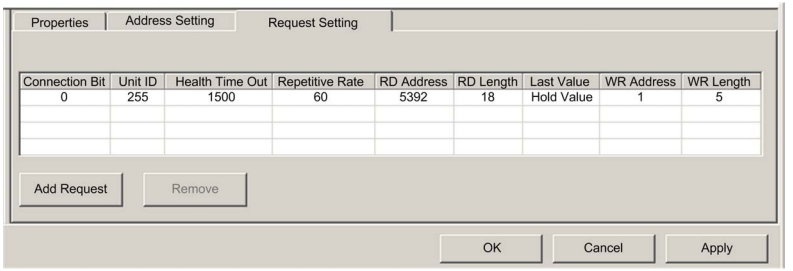
The Ethernet communication module can support up to 128 connections to remote devices. The health of each connection is represented in a single bit value. A health bit value of:

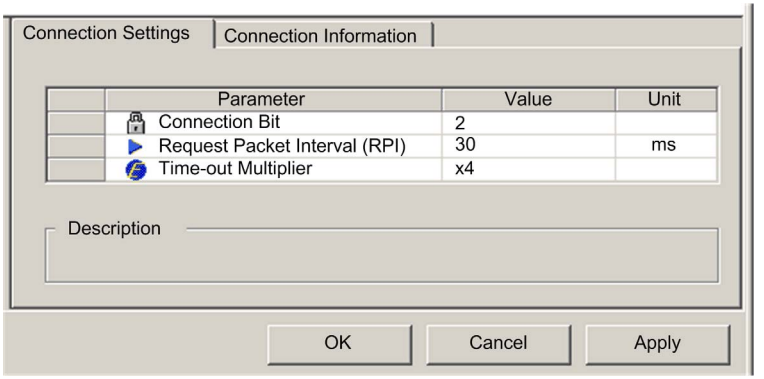
- 1 indicates the connection is active
- 0 indicates the connection is inactive

The health bits are contained in a 32-byte array in the **Variables** page of the **Data Editor**. To display offline this byte array, first sort the variables in ascending order of address, then open the first input variable as shown below:




To determine which health bit is mapped to a specific remote device connection, in the **Device Editor** for the Ethernet communications

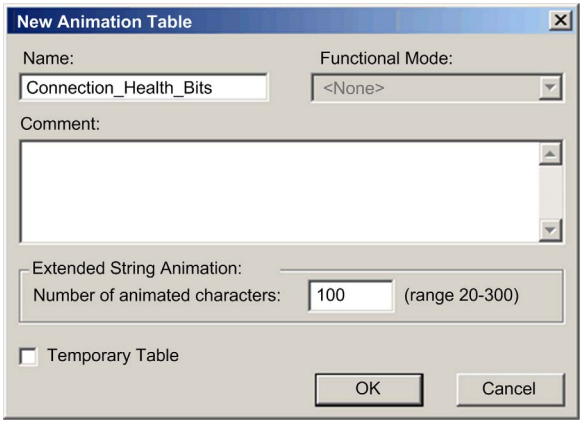
| Step | Action |
|---|---|
| 1 | In the **Device Editor** for the Ethernet communication module, under the **Device List** node, navigate to and select:<br>● for Modbus TCP devices: the main device node<br>● for EtherNet/IP devices: a connection node |
| 2 | For a Modbus TCP device, open the **Request Setting** page and look for the **Connection Bit** number:<br>  <br>In the above example (which displays the left portion of a truncated **Request Setting** page), the **Connection Bit** value of 0 maps to the first bit in the first byte of the **HEALTH_BITS_IN** array, which can be represented as `HEALTH_BITS_IN[0].0`. |

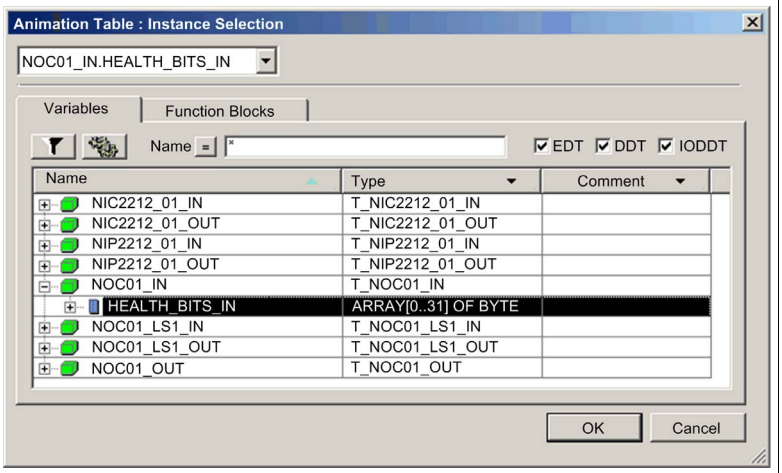
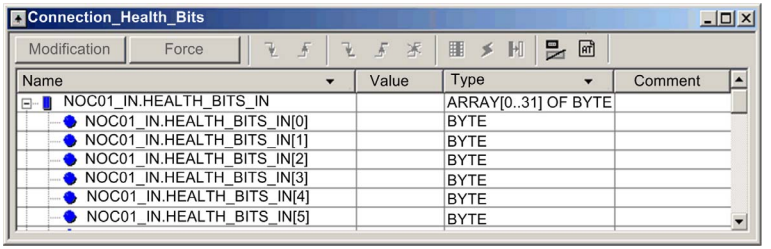
| Step | Action |
|---|---|
| 3 | For an EtherNet/IP device, open the **Connection Settings** page and look for the **Connection Bit** number:<br>  <br>In the above example, the **Connection Bit** value of 2 maps to the third bit in the first byte of the **HEALTH_BITS_IN** array, which can be represented as `HEALTH_BITS_IN[0].2`. |
| 4 | For a local slave, open the local slave configuration page *(see page 104)* and look for the **Connection Bit** number: |

## Monitoring Connection Health Bits in an Animation Table

Use an animation table to monitor the status of connection health bits and other variables. To add health bits to an animation table, follow these steps:

| Step | Action |
|---|---|
| 1 | In the **Project Browser**, select the **Animation Tables** node and click the right mouse button. A pop-up menu opens. |
| 2 | Select **New Animation Table**. |

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td>3</td><td colspan="2">In the New Animation Table dialog, type in values for the following fields:</td></tr>
<tr><td></td><td>Name</td><td>Type in a name for the new animation table. In this example, type in Connection_Health_Bits.</td></tr>
<tr><td></td><td>Number of animated characters</td><td>Accept the default value of 100.</td></tr>
<tr><td></td><td colspan="2">The completed dialog looks like this:<br> 
</td></tr>
<tr><td>4</td><td colspan="2">Click OK. The dialog closes and the new Connection_Health_Bits animation table opens.</td></tr>
<tr><td>5</td><td colspan="2">Double-click on the first empty row in the Name column, then click the ellipsis button . The Instance Selection dialog opens.</td></tr>
</table>

| Step | Action |
|---|---|
| 6 | In the **Instance Selection** dialog, navigate to and select the entire `HEALTH_BITS_IN` array:<br>  |
| 7 | Click **OK** to add the array to the **Connection_Health_Bits** animation table:<br>  <br>Keep in mind that each row represents a byte, which contains eight individual connection health bits. When the DTM for the Ethernet communication module is connected to the physical module, the **Value** field displays a value for the entire byte. |

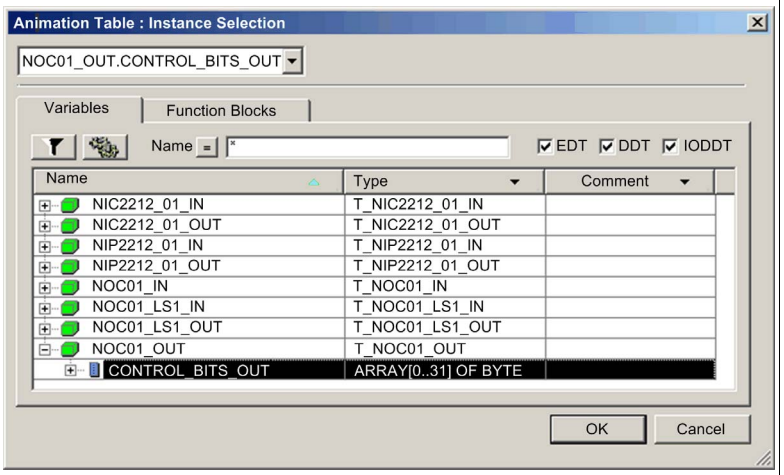
## Modifying Connection Control Bits in an Animation Table

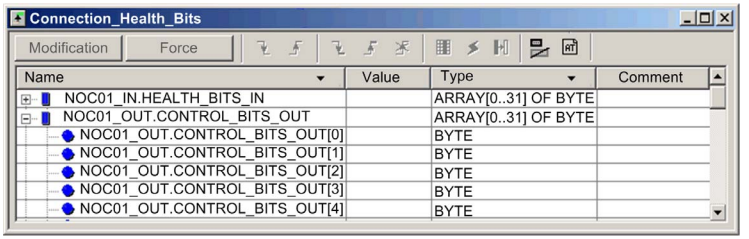
You can also use an animation table to modify the value of a control bit, toggling it on or off.

**NOTE:** Using control bits to toggle a connection on or off (as described below) is the preferred way of regulating communication with a remote device. Toggling a connection control bit on and off does not affect the address location of I/O items. In either case—on or off—the I/O items remain a part of the configuration at the same address locations.

**NOTE:** By contrast, enabling and disabling the **Active Configuration** property for a device or local slave either adds I/O items to, or removes I/O items from, the application. This has the rippling effect of changing the addresses not only for the items of the enabled/disabled device, but also for I/O items relating to other devices in the configuration.

The following example shows you how to add connection control bits to the **Connection_Health_Bits** animation table that you created, above, and use the animation table's **Modification** function to toggle control bits on or off:

| Step | Action |
|---|---|
| 1 | With the **Connection_Health_Bits** animation table open, double-click on the next empty row in the **Name** column, then click the ellipsis button . The **Instance Selection** dialog opens. |
| 2 | In the **Instance Selection** dialog, navigate to and select the entire `CONTROL_BITS_OUT` array:  |

| Step | Action |
|---|---|
| 3 | Click **OK** to add the control bit array to the **Connection_Health_Bits** animation table:<br>  <br><br>Keep in mind that each row represents a byte, which contains eight individual connection control bits. When the DTM for the Ethernet communication module is connected to the physical module, the **Value** field displays a value for the entire byte. |
| 4 | With the DTM for the Ethernet communication module connected to the physical module, double click in the **Value** column for the row (byte) that contains the control bit you want to toggle. |
| 5 | Type a value that toggles the bit (or bits) in the byte you want to change to on or off. For example, suppose the **Value** field of the control bit displays an initial value of **7**. This indicates that the first three (0, 1, and 2) are not established. If you intend to establish the third connection (connection 2), modify the corresponding bit to 0 (type a value of **3**).<br>**NOTE:** When the control bit is 0, the connection is established. When the control bit is 1, the connection is closed. |
| 6 | On your keyboard, press **Enter**. The control bit for the third connection (i.e. connection number 2) is toggled off. |

# Effect of Activating and De-activating Devices on I/O %MW Memory Addresses

## Introduction

Unity Pro assigns a located address in %MW memory to each input and output variable for a remote device and local slave, when that device or slave is activated.

In addition, Unity Pro removes from %MW memory each located variable address whenever the related device or slave is de-activated.

In each case, because of the ordered structure of I/O items in PLC memory *(see page 186)*, the activation and de-activation of a single device causes a rippling effect on the address locations of other I/O variables throughout the application.

Because activating and de-activating devices can cause substantial changes to located variable addresses, Schneider Electric recommends the following practices:

- Activate every device and local slave your application is likely to use, and allow these devices to remain activated.
- If it subsequently becomes necessary to disable communications to a device or slave, instead of de-activating it, use the appropriate control bits to toggle off all connections to that slave or device *(see page 191)*.
- When configuring function blocks in Unity Pro, instead of directly reassigning input and output pins to a specific %MW address, do the following: assign specific input and output pins only to the derived data types and variables automatically created by Unity Pro.

## The Sample Network

The sample network is a part of the same physical network that has been the subject of our continuing configuration example, and includes:

- the Ethernet communication module, named NOC01
- an STB NIC 2212 EtherNet/IP network interface module with I/O modules, named NIC2212_01

Note that, when a new network is created, Unity Pro presents three local slave nodes that can be activated and pre-assigns them device numbers 000, 001, and 002. By default, each local slave is not activated. Therefore, each local slave's inputs and outputs are not initially assigned a %MW memory address.

The following example describes the effect of activating a local slave function after another remote device has already been configured and added to the network. In this ca

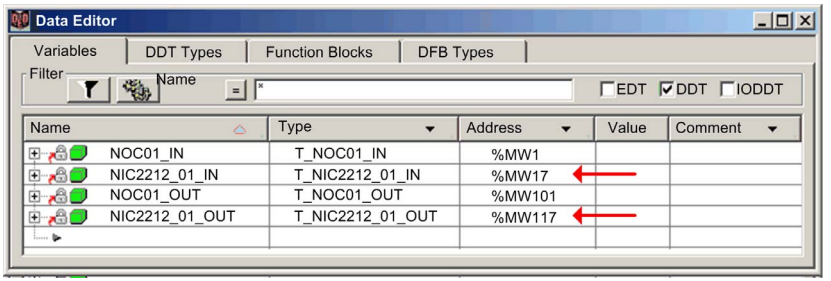
The sample Ethernet network has been configured as follows:

- Total network inputs and outputs are set in the **Configuration** page of the Ethernet communication module in Unity Pro:
  - 100 input words are reserved, beginning at %MW01
  - 100 output words are reserved, beginning at %MW101
- Connection bits for the project include:
  - 32 input bytes (16 words) for health bits with an instance name of NOC01_IN
  - 32 output bytes (16 words) for control bits with an instance name of NOC01_OUT

- Local slave inputs and outputs include:
  - 8 input bytes (4 words) are reserved with an instance name of NOC01_LS1_IN
  - 4 output bytes (2 words) are reserved with an instance name of NOC01_LS1_OUT
- Remote EtherNet/IP device inputs and outputs include:
  - 19 input bytes (10 words) are reserved with an instance name of NIC2212_01_IN
  - 8 output bytes (4 words) are reserved with an instance name of NIC2212_01_OUT

## I/O Assignment Without an Activated Local Slave

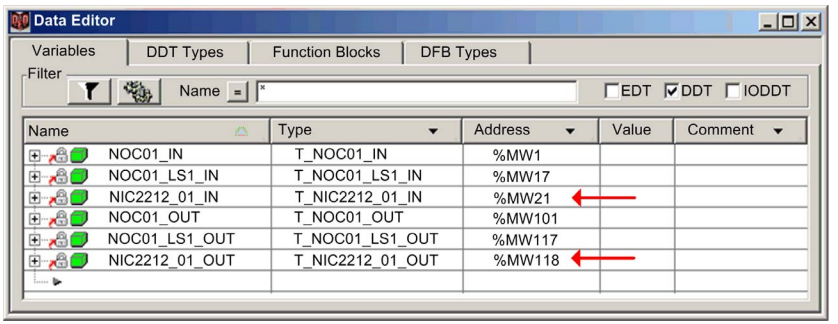
When you click the **Update application** button in the Ethernet communication module **Configuration** page, with the local slave de-activated, Unity Pro auto-generates a collection of variables in support of the application's I/O items at the following instance locations:




Note the address locations of the remote EtherNet/IP device's inputs (%MW17) and outputs (%MW117). As you will see, below, when the local slave is activated, these address locations will change.

## I/O Assignment With an Activated Local Slave

The following example displays input and output variables for the same project. However, in this example the **Active Configuration** setting for the first local slave was set to **Enabled** in the local slave configuration page *(see page 105)*, before the input and output variables were created. As a result clicking the **Update application** button in the Ethernet communication module **Configuration** page generated the following collection of variables:



Notice how the address locations for the remote EtherNet/IP device have shifted:

- inputs (NIC2212_01_IN) have shifted from %MW17 to %MW21
- outputs (NIC2212_01_OUT) have shifted from %MW117 to %MW118

This shift of %MW input and output memory address assignments occurs because the local slave was activated, and local slave I/O variables are placed in a located memory address position ahead of remote EtherNet/IP device I/O variables.

A similar shift of addresses would occur—with respect to both local slave and EtherNet/IP device I/O variable addresses—if a Modbus TCP remote device is activated. This is because Modbus TCP device I/O variables are places in a located memory address position ahead of both local slave and EtherNet/IP I/O variables.

As stated above, a way to avoid this shift of I/O memory addresses is to activate every local slave and remote device that your project may require, and then allow them to remain active. To later disable a device, use the appropriate control bits to toggle off every connection to that device.

# Chapter 5
# Optimizing Performance

## Overview

This chapter describes how to optimize the performance of your Ethernet network.

## What Is in This Chapter?

This chapter contains the following sections:


| Section | Topic | Page |
|---|---|---|
| 5.1 | Selecting a Switch | 198 |
| 5.2 | Control Application Design | 208 |
| 5.3 | Projecting Ethernet Network Performance | 222 |

# Section 5.1
## Selecting a Switch

### Overview

This section describes how to select an Ethernet switch for your network.

### What Is in This Section?

This section contains the following topics:


| Topic | Page |
|---|---|
| Role of a Switch in an Ethernet Network | 199 |
| Transmission Speed, Duplex and Auto-Negotiation | 200 |
| Quality of Service (QoS) | 201 |
| IGMP Snooping | 202 |
| Rapid Spanning Tree Protocol (RSTP) | 203 |
| Virtual Local Area Network (VLAN) | 204 |
| Port Mirroring | 206 |
| Simple Network Management Protocol (SNMP) Agent | 207 |

# Role of a Switch in an Ethernet Network

## Overview

Schneider Electric recommends the use of managed switches—not unmanaged switches or hubs—in process control networks. A managed switch provides more functionality than an unmanaged switch, including the ability to:

- turn switch ports on or off
- configure port speed and duplex settings
- control and monitor message traffic within segments
- prioritize message traffic

## Recommended Switch Features

When acquiring an Ethernet switch for your process control network, confirm that the switch includes the following features:

- Multiple speed (10/100/1000 Mbps)
- Full duplex
- QoS
- IGMP snooping
- RSTP
- VLAN support
- Port mirroring
- SNMP agent

# Transmission Speed, Duplex and Auto-Negotiation

## Introduction

Most Ethernet switches support multiple transmission speeds, full- and half-duplex communication, and offer auto-negotiation capability. Hubs, by contrast, are not designed to support full duplex transmissions.

## Duplex

Full duplex enables a switch port to both transmit and receive messages simultaneously, over two dedicated communication channels. Half duplex, by contrast, permits a port to transmit or receive messages in only one direction at a time. Signal collisions are possible in half duplex communications—because messages are transmitted and received over a single channel. Half duplex communications can cause poor performance and message loss.

## Auto-Negotiation

Auto-negotiation permits a switch port—connected to a remote device that also supports auto-negotiation—to automatically configure itself for the maximum speed and duplex configuration supported by both devices. However, it may be necessary to manually configure the speed and duplex settings of the switch port, if its peer device does not possess auto-negotiation capability.

## Recommendation

Schneider Electric recommends that you employ only switches that support:

- both auto-negotiation and manual configuration of speed and duplex settings
- multiple speeds: 10/100/1000 Mbps
- both full duplex and half duplex

# Quality of Service (QoS)

## Introduction

A switch that supports QoS packet tagging can be configured to deliver higher priority messages before messages with a lower (or no) priority. This enhances system determinism and increases the timely delivery of prioritized messages.

In the absence of QoS tagging, the switch delivers various application messages on a first-in first-out basis. This can result in poor system performance caused by the long forwarding delay—and late delivery—of high priority application messages, which may be handled after lower priority messages.

## Types of QoS

The tagging types are based on the switch configuration:

| Tagging type | Priority mapping rule | Description |
|---|---|---|
| Explicit (QoS tag in Ethernet packet) | DSCP or TOS field in IP header | Each IP based Ethernet packet contains a value in the DSCP or TOS field in its IP header, indicating the QoS priority. The switch forwards packets based on this priority. |
| | VLAN tag in Ethernet header | Each Ethernet packet contains a value in the priority field in the VLAN tag in its Ethernet header, indicating the QoS priority. The switch forwards packets based on this priority. |
| Implicit | Port based | Switch ports are mapped to different QoS priorities. For example, switch port 1 is mapped to QoS priority 1, switch port 2 is mapped to QoS priority 2, etc. |

## Recommendation

Schneider Electric recommends the use of devices—including switches—that support explicit QoS tagging.

**NOTE:** Some switches that support QoS tagging have this feature disabled by default. Confirm that QoS is enabled when deploying each switch.

# IGMP Snooping

## Multicast Messaging

Internet Group Management Protocol (IGMP) is an essential feature of multicast messaging. IGMP instructs routers and switches to forward Ethernet multicast packets to only those device ports that have requested these packets.

In the absence of IGMP snooping, a switch forwards multicast packets out of all its ports, resulting in greater network traffic, wasted network bandwidth, and degraded network performance.

Configure one Ethernet network switch as the IGMP querier. This switch periodically polls the field devices connected to the network, which causes all connected devices to issue an *IGMP Multicast Group Join* message. The group message is received by all network switches, which update their multicast addressing information databases in response.

Similarly, when an Ethernet device transmits an *IGMP Multicast Group Leave* message, all network switches update their multicast addressing information databases by removing the device from their databases.

Multicast messaging reduces network traffic by:

- requiring that a message be sent only once
- sending the message only to devices for which the message is intended

## Recommendation

Schneider Electric recommend the following:

- employ switches that support IGMP V2 or higher
- because IGMP snooping may be disabled by default, enable IGMP snooping for each network switch
- confirm that one switch is configured as the IGMP querier

# Rapid Spanning Tree Protocol (RSTP)

## RSTP

Rapid Spanning Tree Protocol (RSTP) is an OSI layer 2 protocol defined by IEEE 802.1D 2004 that performs the following functions:

- it creates a loop-free logical network path for Ethernet devices that are part of a topology that includes redundant physical paths
- it automatically restores network communication—by activating redundant links—in the event the network experiences a broken link

RSTP software, operating simultaneously in every network switch, obtains information from each switch which enables the software to create a hierarchical logical network topology. RSTP is a flexible protocol that can be implemented on many physical topologies, including ring, mesh, or a combination of ring and mesh.

## Recommendation

Schneider Electric recommends the following practices:

- Use RSTP instead of STP: RSTP provides a faster recovery time than STP
  **NOTE:** Recovery time is the time that elapses between the moment a broken link is detected to the moment network service is restored. Recovery time depends on:
- the number of switches in the topology: the more switches, the longer the recovery time
- the processing speed of the switches in the topology: the slower the speed, the longer the recovery time
- the bandwidth, traffic load, and topology pattern
- If the switch is part of a topology with redundant physical paths: enable RSTP.
- If the switch is part of a topology that does not include redundant physical paths: disable RSTP—in this case, disabling RSTP improves network performance.

# Virtual Local Area Network (VLAN)

## Introduction

Use VLANs to divide a larger network into smaller virtual groups of devices, and to split a switch into many virtual network switches. VLANs permit the creation of logically separate groups of network devices, without having to physically re-wire those devices.

When a switch receives a message directed to a specific VLAN, it forwards that message only to the switch ports connected to devices that are members of that VLAN. The switch does not send the message to other ports.

A VLAN reduces network traffic, blocks multicast and broadcast traffic from other VLANs, provides separation between VLANs, and improves system performance.

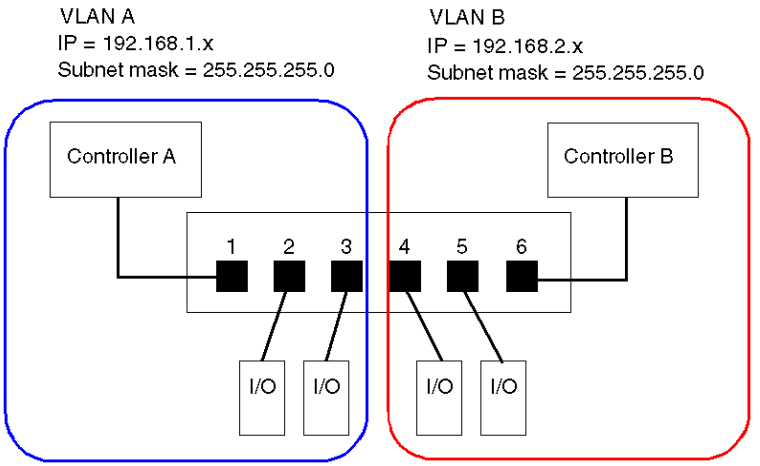
## VLAN Types

Depending upon the switch features, there many different ways to define and implement VLANs:

| Tagging type | Mapping rule | Description |
|---|---|---|
| Explicit (VLAN tag in Ethernet packet) | Tag based | Each VLAN group is assigned a unique VLAN ID, which is included in each Ethernet packet. The switch forwards packets based on VLAN ID. |
| Implicit (no VLAN tag in Ethernet packet) | Port based | Switch ports are assigned to different VLANs, when the switch is configured (see example, below.) |
| | MAC based | A switch maps VLAN group membership—and forwards Ethernet frames—based on device MAC address. |
| | Protocol based | A switch maps VLAN group membership—and forwards Ethernet frames—based on message protocol. |
| | IP-subnet based | A switch maps VLAN group membership—and forwards Ethernet frames—based on IP subnet portion of the target address. |

### Example

In the port-based VLAN example, below, switch ports 1, 2, and 3 are assigned to VLAN A, while switch ports 4, 5, and 6 are assigned to VLAN B:



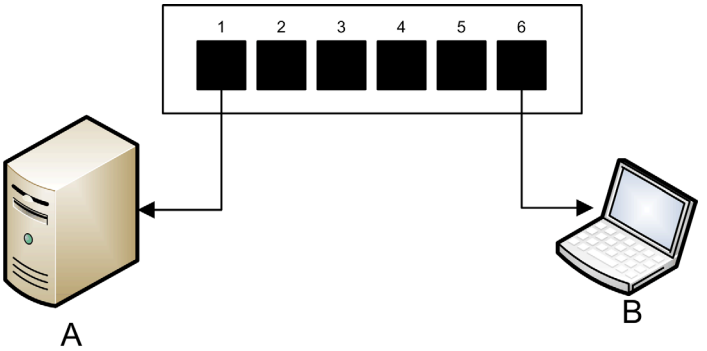

**NOTE:** A single port can be a member of multiple VLANs.

# Port Mirroring

## Introduction

Port mirroring lets you troubleshoot switch port transmissions by copying the traffic that passes through one port (the source or mirrored port) and sending the copied transmission to a second port (the destination or mirror) port, where the packets can be examined.

In the following example, the data packets transmitted over port 1 are copied and sent to port 6. To troubleshoot port 1, a PC with packet sniffing software is used to analyze the traffic on port 6 and thereby troubleshoot port 1.




**A** target device of port 1 transmissions
**B** PC with packet sniffing software connected to port 6, which mirrors port 1 transmissions

Port mirroring does not affect the normal forwarding behavior of the mirrored port. In many switches, you can configure port mirroring so that you can forward and examine:

- only the incoming packets of a single mirrored port
- only the outgoing packets of a single mirrored port
- both the incoming and outgoing packets of a single mirrored port
- the packets of several mirrored ports—or the whole switch

A packet sniffer's troubleshooting features should include:

- analyzing network performance
- monitoring network activity

## Recommendation

Schneider Electric recommends implementing port mirroring as follows:

- Use a destination or mirror port only for port mirroring and not for any other purpose. Connect only the PC with packet sniffer to the mirroring port.
- When configuring the switch, confirm that port mirroring is designed to forward packets—e.g., incoming, outgoing, or both—to meet your requirements.
- A packet sniffer's troubleshooting features should include the capabilities of analyzing network performance and monitoring network activity.

## Simple Network Management Protocol (SNMP) Agent

An *SNMP agent* is a software component that responds to queries about the management data of the switch, and reports events to another device acting as an SNMP manager.

The management data for a switch can include:

- operational state information (interface status, mode of operation, etc.)
- configuration parameters (IP address, features enabled / disabled, timer values, etc.)
- performance statistics (frame counters, event logs, etc.)

If a switch is equipped with SNMP agent software, a designated SNMP manager can:

- retrieve management data about the switch
- control the switch by editing its configuration settings
- receive traps—or notices of events—affecting the state of the switch

# Section 5.2
## Control Application Design

### Overview

In a control system, control and automation are achieved by processing and delivering various application service messages.

Understanding messages, allocating network bandwidth among messages, and determining the time required for a message to traverse the network are all major performance considerations of your control application design.

### What Is in This Section?

This section contains the following topics:


| Topic | Page |
|---|---|
| Message Types | 209 |
| Message Connection Types | 211 |
| TCP and CIP Connections | 213 |
| Message Priority | 214 |
| Messaging Performance | 215 |
| Message Frequency | 216 |
| Allocating Network Bandwidth | 218 |
| Estimating Message Traverse and Response Times | 220 |

# Message Types

## Overview

Two types of industrial Ethernet message types are supported by the Ethernet communication module:

| Message Type | Includes... |
|---|---|
| Explicit | ● Non-time critical management data<br>● Read/write application data |
| Implicit | ● Real-time I/O data<br>● Real-time control data<br>● Real-time synchronization data |

## Explicit Messages

Explicit messages transmit information used for device configuration and diagnostics, and for data collection. In explicit messaging, the client issues a request; the server receives, processes, and sends a response back to the client.

You can specify a response timeout value, indicating how long the client waits for a response from the server. If the client does not receive a response from the server within the response timeout period, the client reissues its request. The length of the response timeout will vary depending on the requirements of your application.

Examples of explicit messages include: SNMP messages, FTP messages, CIP establish connection messages, EtherNet/IP query and response messages, and DHCP messages.

The characteristics of explicit messaging are:
- point-to-point client-server mode
- variable size
- variable frequency
- long response time
- long connection timeout

Explicit messages can be sent as either connected or unconnected, depending on the frequency of your need for data, and on the level of service required:

| Message type | Characteristics |
|---|---|
| Connected | ● Begins when an originating device initiates a connection by sending a request to a target device.<br>● The connection is established when the originator receives a successful response from the target.<br>● A CIP connected message has a higher priority and provides better service, but requires a greater amount of resources from both the target and originator devices.<br>● Used for recurring requests, and for high priority parameter monitoring.<br>● Typically use short response timeout settings. |

| Message type | Characteristics |
|---|---|
| Unconnected | ● Less resource intensive.<br>● Used for less frequent requests, and for lower priority parameter monitoring.<br>● Typically use very long response timeout settings. |

**NOTE:** The response timeout can be configured using the **EM Request Timeout** parameter (located in the **Channel Properties** →**EtherNet/IP** page).

### Implicit Messages

Implicit messages consist of packets of data that are time critical. Implicit messages are used for real-time control and synchronization. Examples of implicit messages include: real-time I/O data, motion control data, functional diagnostic data, real-time synchronization data, and network topology management data.

Implicit messages require determinism and high performance in message processing and delivery.

The characteristics of implicit messaging are:
- producer/consumer mode (EtherNet/IP) or client/server mode (Modbus TCP)
- small, fixed data size
- fixed frequency
- short response time
- short connection timeout

# Message Connection Types

## Introduction

The transmission of most messages require a point-to-point connection between a transmitter and receiver.

For all types of explicit messages, the connection automatically closes when the communication ends, or is timed-out.

For implicit messages, keep the connection open. If the I/O connection—CIP for EtherNet/IP, TCP for Modbus TCP—the transmission stops. In this case, the scanner employs the TCP implicit messaging connection to dynamically re-establish the CIP connection.

## Calculating the Connection Timeout

For CIP connections, you can control the connection timeout setting by specifying both the network multiplier and the requested packet interval (RPI in ms):

**Timeout = Network Multiplier x RPI**

**NOTE:** You can locate and configure these values in the Unity Pro Ethernet Configuration Tool. Open the **DTM Editor** for the Ethernet communication module, then edit the following settings:

- the network multiple is the **Time-out Multiplier** parameter found in the **Device List** →**<device>** →**<connection>** →**Connection Settings** page, and
- the RPI is the **EM Connection RPI** parameter found in the **Channel Properties** →**EtherNet/IP** page

A large timeout value may affect the ability of the network to optimize the availability of connection resources, re-establish connections, and update I/O data when the connection is lost.

A small timeout value may unnecessarily cause the frequent closing and re-establishing of connections.

It is preferable to use a larger timeout value for explicit messaging connections, and a smaller timeout value for implicit messaging connections. The specific value you employ depends on your application requirements.

## Connection Types and Protocols

The connection type and transport protocol employed depends upon the message type and message protocol, as follows:

| Message Type | Message Protocol | Connection Type | Connection Protocol |
|---|---|---|---|
| Explicit | EtherNet/IP | CIP, TCP | TCP/IP |
| | Modbus TCP | TCP | TCP/IP |
| | FTP | TCP | TCP/IP |
| | HTML (web) | TCP | TCP/IP |
| | SMTP | TCP | TCP/IP |
| | SNMP | N/A | UDP/IP |
| | SNTP | N/A | UDP/IP |
| | DHCP | N/A | UDP/IP |
| | BOOTP | N/A | UDP/IP |
| Implicit | EtherNet/IP | CIP, TCP | UDP/IP |
| | Modbus TCP | TCP | TCP/IP |
| | IGMP | N/A | IP |
| | RSTP | N/A | Ethernet |

## Connection- Overhead

Any message transmission includes overhead, which consumes network bandwidth and processing time. The smaller the size of the data transmitted, the relatively greater the portion of the message allocated to overhead.

Consequently, it makes sense to design your I/O messaging by consolidating data from multiple I/O devices—with similar processing capabilities and performance needs—and transmitting it through a single adapter. This design conserves bandwidth, saves network resources, and improves performance.

# TCP and CIP Connections

## Number of Connections Supported

The Ethernet communication module employs both TCP and CIP connections to support both implicit and explicit messages, as follows:

| Connection Type | Maximum Number of Connections per Module |
|---|---|
| CIP | 256 |
| TCP | 128 |

**NOTE:**

- A single TCP connection can support multiple CIP connections.
- The maximum number of TCP connections does not include connections dedicated to other services, for example, FTP and Web connections.

# Message Priority

## QoS

The routers and switches that comprise your network infrastructure cannot distinguish between explicit message and implicit messages. However, these devices—including the Ethernet communication module—can support QoS Ethernet packet tagging.

Using Qos tagging, these devices can handle messages they send and receive according to each message's tagged priority, forwarding higher priority messages before lower priority messages.

# Messaging Performance

## Maximum Messaging Load

The Ethernet communication module supports a the following maximum messaging loads:

| Message Type | Maximum Messaging Load |
|---|---|
| Implicit (EtherNet/IP plus Modbus TCP) | 12000 packets per second, with no simultaneous explicit messages |
| Explicit (EtherNet/IP plus Modbus TCP) | 120 packets per second, with a maximum of 6000 simultaneous implicit messages |

# Message Frequency

## Introduction

The term *message frequency* refers to how often a device transmits a particular type of message. Message frequency directly affects control network load and performance, as well as the CPU capacity of every network device that processes these messages.

Depending on your application requirements, real-time I/O data can be transmitted using implicit messaging as follows:

- on a cyclic basis, at the *request packet interval* (RPI) rate, or
- upon the occurrence of a change of state event

## Cyclic Real-Time I/O Messaging

Much of the load on an Ethernet control network consists of cyclic real-time I/O data. Consequently, carefully consider how to set the RPI value for transmitting these messages:

- A small RPI value results in more frequent, and more numerous, message transmissions. This increases network load, and may waste network resources and degrade system performance.
- Conversely, a larger RPI value—for example, one that is equal (or nearly equal) to the frequency of your application's need for new data—can result in your application not receiving the most current data. Also, if a connection is lost, the time to re-establish the connection will be relatively long, because the connection timeout is proportional to the RPI.

Schneider Electric recommends setting RPI to 50% of the actual frequency by which your application requires data for cyclic real-time I/O messaging.

**NOTE:** The I/O scanner can simultaneously communicate with different I/O adapters at different RPI rates. This enhances the ability of the PLC to control and monitor different devices with varying processing capacities.

## Change of State I/O Messaging

For change of state triggered real-time I/O data messages:

- output transmissions occur at the rate of the PLC controller application cycle time
- input transmissions occur whenever an input event is detected by an input device

Consequently, for an I/O device with a rapid response and transmission time, using a direct connection to the I/O device may be more efficient than using a rack optimized connection. In this design, because only the single device input data is sent, the size of the frequently transmitted message is potentially much smaller than would be the case if the message contained data from every I/O device on the remote island.

**NOTE:** A change of state (versus cyclic) triggered real-time I/O message usually reduces network load. Configure the change of state message with a longer connection timeout value.

## RSTP and IGMP Messaging

RSTP and IGMP messages usually consume a very small amount of network bandwidth. Set up the IGMP query period based on your application requirements.

### Scheduling Certain Explicit Messages

Depending on your application requirements, you can also configure certain explicit messages to be transmitted either cyclically or upon the occurrence of a change of state event. For example, you can periodically monitor a device using SNMP query, Web pages, EtherNet/IP, and Modbus TCP. The cyclic period should be configured so that the total load consumed by explicit messaging does not exceed 10% of network capacity.

# Allocating Network Bandwidth

## Introduction

Maximum network bandwidth equals your network speed, for example 100 Mbps. When designing your control network, allocate network bandwidth among the control application messages required by your application.

**NOTE:** Schneider Electric recommends you reserve at least the following amounts for processing explicit messaging:

- 10% of network bandwidth
- 10% of CPU processing capacity for each network device

## Message Load and Message Bandwidth

*Message Load*—in packets per second (PPS)—represents the number of packets in a single message that are received and sent within one second. *Message Load* can be estimated as follows:

**Message Load =**

**(number of packets per connection) x (number of connections) / RPI**

The *number of packets per connection* value depends on the capacity of the device, and can be either:

- 1: for connections that support uni-directional communication
- 2: for connections that support input and output (for producer/consumer mode) or request and response (for client/server mode) per one time bi-directional exchange, or

The connection can be used for either explicit or implicit messaging. For UDP-based explicit messaging, assume that each client represents one connection, and that messages are transmitted cyclically.

*Message Bandwidth* (in bits) can be calculated as follows:

**Message Bandwidth = message packet size (bits) x Message Load**

Based on the portion of network bandwidth you want to allocate to a particular message, you can use the *Message Load* and *Message Bandwidth* formulae to calculate the fastest RPI for the message.

## Device Load and Device Bandwidth

*Device Load*—measured in number of packets—represents the load contributed by messages received and sent by a device within one second. *Device Load* is the sum of the *Message Load* values for every message handled by the device.

If the *Device Load* exceeds the device's processing capability, performance of both the device and the network is degraded.

**NOTE:** Schneider Electric recommends that *Device Load* not exceed 90% of CPU processing capacity of each device.

*Device Bandwidth*—measured in bits—is the sum of the *Message Bandwidth* values for messages handled by the device

In your control application design, determine whether the I/O scanner device can handle the load contributed by every I/O adapter device. To do this, perform the following steps:

1. Calculate the implicit messaging load and bandwidth for each remote device.
2. Sum the load and bandwidth estimates for every remote device.
3. Compare the total implicit messaging load and bandwidth against the maximum implicit messaging capacity of the device acting as I/O scanner.

If the projected total load or bandwidth for a communication module acting as an I/O scanner exceeds its implicit messaging load or bandwidth limits, consider one or more of the following corrective actions:

- If the I/O adapter supports rack optimized connections, and if a single rack of digital I/O uses multiple direct connections, replace the direct connections with a single rack optimized connection, if possible.
- Increase the RPI setting for a device where possible.
- Add another communication module to act as an I/O scanner, and re-design the network in order to share the load.

### Network Load and Network Bandwidth

*Network Load*—measured in number of packets—can be estimated as the sum of the *Device Load* of the adapter devices, or of the scanner devices.

*Network Bandwidth*—measured in bits—can be estimated as the sum of the *Device Bandwidth* of the adapter devices, or of the scanner devices.

**NOTE:** Schneider Electric recommends that *Network Load* not exceed 90% of maximum network bandwidth.

If necessary, you may need to optimize your control application design by:

- adjusting device RPI settings
- changing connection types (e.g., from direct to rack optimized)
- modify the configuration
- change the network topology

# Estimating Message Traverse and Response Times

## Message Traverse Time

*Message Traverse Time* is defined as the time required for a message to travel from its point of origin to its targeted destination over a network path. As the messages travels over the network path, it may pass through—and be forwarded by—a number of intermediate network devices, including switches and routers.

*Message Traverse Time* is impacted by several factors, including, for example, the following:

- the number of forwarding network devices
- the transmission delay of each forwarding device
- network load
- message priority

*Message Traverse Time* can be estimated by determining the transmission delay (the store and forward delay) of intermediate network devices and counting the number of such devices. Assuming each forwarding device is a switch, and each switch presents the same transmission delay, the following formula can be used:

**Message Traverse Time =**

**(Switch Transmission Delay) x (Number of Switches)**

Schneider Electric recommends that you estimate a worst-case *Message Traverse Time*, as follows:

| Step | Description |
|---|---|
| 1 | Determine the worst case network load. |
| 2 | Obtain switch performance information, under varying network loads, and use the worst case—i.e., the largest—transmission delay value. |
| 3 | Determine the logical network topology that yields the longest path—i.e. the greatest number of switches—through which a message passes. |
| 4 | Using the largest transmission delay value and the largest number of forwarding switches, use the formula (above) to calculate a worst-cast *Message Traverse Time*. |

## Message Response Time

After calculating *Message Traverse Time* (above), you can next measure *Message Response Time*, which measures the total time required for:

- a message to travel from a client device over the network to a server
- the message to be processed by the server
- the server response to travel back to the client over the network

*Message Response Time* can be calculated as follows:

**Message Response Time =**

**(2 x (Message Traverse Time)) + (Server Processing Time)**

In the above formula, ‘2’ indicates a round trip required for client/server communication.

After *Message Response Time* is calculated, you can determine and configure the following parameters, both of which are found in the **Channel Properties** →**EtherNet/IP** page of the Unity Pro Ethernet Configuration Tool:

- **EM Request Timeout** value, and
- **EM Connection RPI**

# Section 5.3
# Projecting Ethernet Network Performance

## Network Load and Bandwidth Calculation Example

### Network Devices

This example estimates the performance for an Ethernet network composed of the following devices:

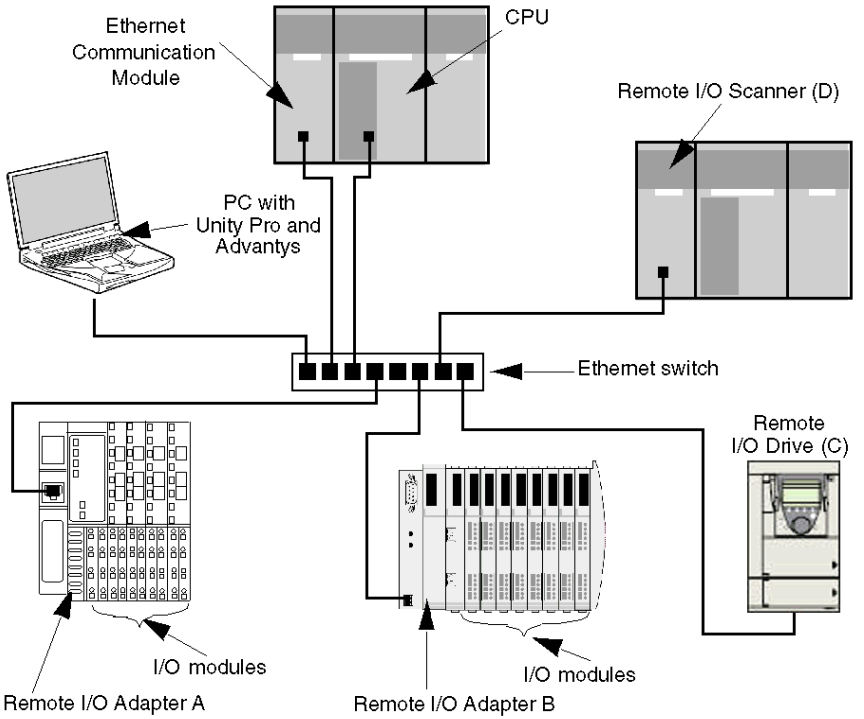
- a PLC that controls 3 remote I/O stations (A, B, and C)
- BMX NOC 0401 Ethernet communication module, acting as the local I/O scanner, installed in the PLC rack
- an 8-port Ethernet managed switch
- a PC running used to obtain diagnostic data via explicit messages running the following software:
  - Unity Pro
  - the Unity Pro Ethernet Configuration Tool
- 4 remote devices, acting as:
  - an I/O adapter (A) for a rack of I/O modules
  - a second I/O adapter (B) for a rack of I/O modules
  - a remote I/O drive (C)
  - a remote I/O scanner (D)

Unity Pro software running in the PC is used to configure the CPU controller.

For programming purposes you need a connection to the PLC either through the CPU's Ethernet port or other supported programming paths.

## Network Diagram

The proposed network diagram looks like this:




## Network Load and Bandwidth Limits

When performing calculations, keep in mind that the Ethernet module and remote devices cannot exceed their implicit messaging and bandwidth limits:

| Device | Load Limits | Bandwidth Limits |
|---|---|---|
| Ethernet Communication Module | 12000 pps | 80 Mbps |
| I/O Adapter (A) | 8000 pps | 70 Mbps |
| I/O Adapter (B) | 8000 pps | 70 Mbps |
| I/O Drive (C) | 8000 pps | 70 Mbps |
| I/O Scanner (D) | 12000 pps | 80 Mbps |
| Switch | 16000 pps | 90 Mbps |

## Remote Device Connections and RPI

For the purpose of this example, it is assumed that the remote devices require the following numbers of CIP connections, and are configured for the stated requested packet interval (RPI) settings:

| Device | CIP I/O Connections | RPI Setting | I/O Packet Size |
|---|---|---|---|
| I/O Adapter (A) | 5 | 20 ms | 8000 bits |
| I/O Adapter (B) | 2 | 30 ms | 4096 bits |
| I/O Drive (C) | 2 | 30 ms | 8000 bits |
| I/O Scanner (D) | 2 | 50 ms | 8000 bits |

For the purposes of this example, it is also assumed that every connection is bi-directional.

## I/O Scanner Calculations

The Ethernet communication module, acting as local I/O scanner, has to handle the implicit messaging load contributed by the remote devices. Your task is to:

1. estimate the implicit messaging load and bandwidth contributed by each remote device
2. sum the load and bandwidth values for each remote device
3. compare the total load and bandwidth against the maximum implicit messaging capacity of the local I/O scanner

Recall that the implicit messaging load calculation formula for a single remote device is:

**Load = (number of packets per connection) x (number of connections) / RPI**

Because every connection is assumed to be bi-directional, the *number of packets per connection* value is 2. Consequently, the estimated implicit messaging load contributed by each device, and the total implicit messaging load the local I/O scanner has to handle can be estimated as follows:

Load:

| Device | Number of packets per connection | X | Number of connections | ÷ | RPI | = | Load |
|---|---|---|---|---|---|---|---|
| I/O Adapter (A) | 2 | X | 5 | ÷ | 20 ms | = | 500 pps |
| I/O Adapter (B) | 2 | X | 2 | ÷ | 30 ms | = | 134 pps |
| I/O Drive (C) | 2 | X | 2 | ÷ | 30 ms | = | 134 pps |
| I/O Scanner (D) | 2 | X | 2 | ÷ | 50 ms | = | 80 pps |
| | | | | | Total | = | 848 pps |
| | | | | | Switch | = | 848 pps |

Bandwidth:

| Device | Packet size | X | Load | = | Bandwidth |
|---|---|---|---|---|---|
| I/O Adapter (A) | 8000 bits | X | 500 pps | = | 4 Mbps |
| I/O Adapter (B) | 4096 bits | X | 134 pps | = | 0.554 Mbps |
| I/O Drive (C) | 8000 bits | X | 134 pps | = | 1.07 Mbps |
| I/O Scanner (D) | 8000 bits | X | 80 pps | = | 0.64 Mbps |
| Total | | | | = | 6.26 Mbps |
| Switch | | | | = | 6.26 Mbps |

## Conclusion

The projected total load for the module—848 pps—is within the device implicit messaging limit of 12000 data packets per second. The projected total bandwidth for the communication module—6.26 Mbps—is also within the device implicit messaging bandwidth limit of 80 Mbps. The projected total load and bandwidth for the remote devices (including the switch) are also within their 90% load and bandwidth limits:

| Device | 90% of Load Limit | 90% of Bandwidth Limit |
|---|---|---|
| Ethernet Communication Module | 10800 pps | 72 Mbps |
| I/O Adapter (A) | 7200 pps | 63 Mbps |
| I/O Adapter (B) | 7200 pps | 63 Mbps |
| I/O Drive (C) | 7200 pps | 63 Mbps |
| I/O Scanner (D) | 10800 pps | 72 Mbps |

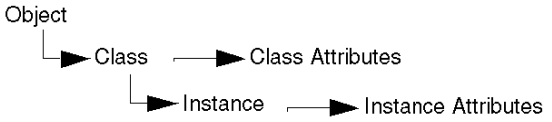
**NOTE:** Although message load contributed by explicit messaging are not included in the above calculations, such load contributions are presumed to be less than 10% of the device load and bandwidth.

# Chapter 6
# CIP Objects

## Overview

The Ethernet communication module can access CIP data and services located in connected devices. The CIP objects and their content depends on the design of each device.

CIP object data and content are exposed—and accessed—hierarchically in the following nested levels:




**NOTE:** You can use explicit messaging to access either:

- a collection of instance attributes, by including in the explicit message address only the object's class and instance values, or
- a single attribute, by extending the explicit message address to include not only the object's class and instance values but also a specific attribute value

When the Ethernet communication module's local slave service is activated, remote devices can send explicit messages to the module's CIP object structure and:

- access module data, or
- execute module commands

This chapter describes the CIP objects the Ethernet communication module exposes to remote devices.

## What Is in This Chapter?

This chapter contains the following topics:


| Topic | Page |
|---|---|
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| Assembly Object | 231 |
| Connection Manager Object | 233 |
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| Quality Of Service (QoS) Object | 237 |
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| IO Connection Diagnostics Object | 251 |
| EtherNet/IP Explicit Connection Diagnostics Object | 255 |
| EtherNet/IP Explicit Connection Diagnostics List Object | 257 |

# Identity Object

## Overview

The Identity object presents the instances, attributes and services described below.

## Class ID

01

## Instance IDs

The Identity object presents two instances:

- 0: class
- 1: instance

## Attributes

Identity object attributes are associated with each instance, as follows:

Instance ID = 0 (class attributes):

| Attribute ID | Description | GET | SET |
|---|---|---|---|
| 01 | Revision | X | — |
| 02 | Max Instance | X | — |
| X = supported<br>— = not supported | | | |

Instance ID = 1 (instance attributes):

| Attribute ID | | Description | Type | GET | SET |
|---|---|---|---|---|---|
| hex | dec | | | | |
| 01 | 01 | Vendor ID | UINT | X | — |
| 02 | 02 | Device Type | UINT | X | — |
| 03 | 03 | Product Code | UINT | X | — |
| 04 | 04 | Revision | STRUCT | X | — |
| | | Major | USINT | | |
| | | Minor | USINT | | |
| X = supported<br>— = not supported | | | | | |

| Attribute ID | | Description | Type | GET | SET |
|---|---|---|---|---|---|
| hex | dec | | | | |
| 05 | 05 | Status<br>bit 2:<br>0x01=the module is configured<br>bits 4-7:<br>0x03=no I/O connections established<br>0x06=at least 1 I/O connection in run mode<br>0x07=at least 1 I/O connection established, all in IDLE mode | Word | X | — |
| 06 | 06 | Serial Number | UDINT | X | — |
| 07 | 07 | Product Name | STRING | X | — |
| 18 | 24 | Modbus Identity | STRUCT | X | — |
| X = supported<br>— = not supported | | | | | |

## Services

The Identity object performs the following services upon the listed object types:

| Service ID | | Description | Class | Instance | Notes |
|---|---|---|---|---|---|
| hex | dec | | | | |
| 01 | 01 | Get_Attributes_All | X | X | Returns:<br>● all class attributes (instance = 0)<br>● instance attributes 1 to 7 (instance = 1) |
| 0E | 14 | Get_Attribute_Single | X | X | Returns the value of the specified attribute. |
| X = supported<br>— = not supported | | | | | |

# Assembly Object

## Overview

The Assembly object consists of the attributes and services described below.

**NOTE:** You can send an explicit message to the Assembly object only when no other connections have been established that read from or write to this object. For example, you can send an explicit message to the Assembly object if a local slave instance is enabled, but no other module is scanning that local slave.

## Class ID

04

## Instance IDs

The Assembly object presents the following instance identifiers:

- 0: class
- 101, 102, 111, 112, 121, 122: instance

## Attributes

The Assembly object consists of the following attributes:

Instance ID = 0 (class attributes):

| Attribute ID | Description | GET | SET |
|---|---|---|---|
| 01 | Revision | X | — |
| 02 | Max Instance | X | — |
| 03 | Number of Instances | X | — |
| X = supported<br>— = not supported | | | |

Instance attributes:

| Instance ID | Attribute ID | Description | Type | GET | SET |
|---|---|---|---|---|---|
| 101 | 03 | Local slave 1: T->O input data | Array of BYTE | X | — |
| 102 | | Local slave 1: O>T | Array of BYTE | X | X |
| 111 | | Local slave 2: T->O input data | Array of BYTE | X | — |
| 112 | | Local slave 2: O>T | Array of BYTE | X | X |
| 121 | | Local slave 3: T->O input data | Array of BYTE | X | — |
| 122 | | Local slave 3: O>T | Array of BYTE | X | X |
| X = supported<br>— = not supported | | | | | |

## Services

The CIP Assembly object performs these services upon the listed object types:

| Service ID | | Description | Class | Instance | Notes |
|---|---|---|---|---|---|
| hex | dec | | | | |
| 0E | 14 | Get_Attribute_Single | X | X | Returns the value of the specified attribute |
| 10 | 16 | Set_Attribute_Single[1] | — | X | Returns these values:<br>0E=attribute not settable: assembly is not o->T type<br>0F=permission denied: assembly is being used by an active connection<br>13=config too small: the Set_Attribute_Single command contains partial data<br>15=data too big: the Set_Attribute_Single command contains too much data |
| X = supported<br>— = not supported | | | | | |
| 1. When valid, the size of the data written to the Assembly object using the Set_Attribute_Single service equals the size of the Assembly object as configured in the target module. | | | | | |

# Connection Manager Object

## Overview

The Connection Manager object presents the instances, attributes and services described below.

## Class ID

06

## Instance IDs

The Connection Manager object presents two instance values:

- 0: class
- 1: instance

## Attributes

Connection Manager object attributes are associated with each instance, as follows:

Instance ID = 0 (class attributes):

| Attribute ID | Description | GET | SET |
|---|---|---|---|
| 01 | Revision | X | — |
| 02 | Max Instance | X | — |
| X = supported<br>— = not supported | | | |

Instance ID = 1 (instance attributes):

| Attribute ID | | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|---|
| hex | dec | | | | | |
| 01 | 01 | Open Requests | UINT | X | X | Number of Forward Open service requests received |
| 02 | 02 | Open Format Rejects | UINT | X | X | Number of Forward Open service requests that were rejected due to bad format |
| 03 | 03 | Open Resource Rejects | UINT | X | X | Number of Forward Open service requests that were rejected due to lack of resources |
| 04 | 04 | Open Other Rejects | UINT | X | X | Number of Forward Open service requests that were rejected for reasons other than bad format or lack of resources |
| X = supported<br>— = not supported | | | | | | |

| Attribute ID | | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|---|
| hex | dec | | | | | |
| 05 | 05 | Close Requests | UINT | X | X | Number of Forward Close service requests received |
| 06 | 06 | Close Format Requests | UINT | X | X | Number of Forward Close service requests that were rejected due to bad format |
| 07 | 07 | Close Other Requests | UINT | X | X | Number of Forward Close service requests that were rejected for reasons other than bad format |
| 08 | 08 | Connection Timeouts | UINT | X | X | Total number of connection timeouts that occurred in connections controlled by this connections manager |
| 09 | 09 | Connection Entry List | STRUCT | X | — | 0 (Unsupported optional item |
| 0B | 11 | CPU_Utilization | UINT | X | — | 0 (Unsupported optional item |
| 0C | 12 | MaxBuffSize | UDINT | X | — | 0 (Unsupported optional item |
| 0D | 13 | BufSize Remaining | UDINT | X | — | 0 (Unsupported optional item |
| X = supported<br>— = not supported | | | | | | |

## Services

The Connection Manager object performs the following services on the listed object types:

| Service ID | | Description | Class | Instance | Notes |
|---|---|---|---|---|---|
| hex | dec | | | | |
| 01 | 01 | Get_Attributes_All | X | X | Returns the value of all attributes. |
| 0E | 14 | Get_Attribute_Single | X | X | Returns the value of the specified attribute. |
| X = supported<br>— = not supported | | | | | |

# Modbus Object

## Overview

The Modbus object converts EtherNet/IP service requests to Modbus functions, and Modbus exception codes to CIP General Status codes. It presents the instances, attributes and services described below.

## Class ID

44 (hex), 68 (decimal)

## Instance IDs

The Modbus object presents two instance values:

- 0: class
- 1: instance

## Attributes

The Modbus object consists of the following attributes:

Instance ID = 0 (class attributes):

| Attribute ID | Description | GET | SET |
|---|---|---|---|
| 01 | Revision | X | — |
| 02 | Max Instance | X | — |
| X = supported<br>— = not supported | | | |

Instance ID = 1 (instance attributes):

| Attribute ID | Description | Type | GET | SET |
|---|---|---|---|---|
| — | No instance attributes are supported | — | — | — |

## Services

The Modbus object performs the following services upon the listed object types:

| Service ID | | Description | Class | Instance |
|---|---|---|---|---|
| hex | dec | | | |
| 0E | 14 | Get_Attribute_Single | X | X |
| 4B | 75 | Read_Discrete_Inputs | — | X |
| X = supported<br>— = not supported | | | | |

| Service ID | | Description | Class | Instance |
|---|---|---|---|---|
| **hex** | **dec** | | | |
| 4C | 76 | Read_Coils | — | X |
| 4D | 77 | Read_Input_Registers | — | X |
| 4E | 78 | Read_Holding_Registers | — | X |
| 4F | 79 | Write_Coils | — | X |
| 50 | 80 | Write_Holding_Registers | — | X |
| 51 | 81 | Modbus_Passthrough | — | X |
| X = supported<br>— = not supported | | | | |

# Quality Of Service (QoS) Object

## Overview

The QoS object implements Differentiated Services Code Point (DSCP or *DiffServe*) values for the purpose of providing a method of prioritizing Ethernet messages. The QoS object presents the instances, attributes and services described below.

## Class ID

48 (hex), 72 (decimal)

## Instance IDs

The QoS object presents two instance values:

- 0: class
- 1: instance

## Attributes

The QoS object consists of the following attributes:

Instance ID = 0 (class attributes):

| Attribute ID | Description | GET | SET |
|---|---|---|---|
| 01 | Revision | X | — |
| 02 | Max Instance | X | — |
| X = supported<br>— = not supported | | | |

Instance ID = 1 (instance attributes):

| Attribute ID | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|
| 04 | DSCP Urgent | USINT | X | X | For CIP transport class 0/1 Urgent priority messages, default value = 55. |
| 05 | DSCP Scheduled | USINT | X | X | For CIP transport class 0/1 Urgent priority messages, default value = 47. |
| X = supported<br>— = not supported | | | | | |

| Attribute ID | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|
| 06 | DSCP High | USINT | X | X | For CIP transport class 0/1 Urgent priority messages, default value = 43. |
| 07 | DSCP Low | USINT | X | X | For CIP transport class 0/1 Urgent priority messages, default value = 31. |
| 08 | DSCP Explicit | USINT | X | X | For CIP explicit messages (transport class 2/3 and UCMM), default value = 27. |
| X = supported<br>— = not supported | | | | | |

**NOTE:** A change in the instance attribute value takes effect on device re-start, for configurations made from flash memory.

## Services

The QoS object performs the following services upon the listed object types:

| Service ID | | Description | Class | Instance |
|---|---|---|---|---|
| hex | dec | | | |
| 0E | 14 | Get_Attribute_Single | X | X |
| 10 | 16 | Set_Attribute_Single | — | X |
| X = supported<br>— = not supported | | | | |

# TCP/IP Interface Object

## Overview

The TCP/IP interface object presents the instances, attributes and services described below.

## Class ID

F5 (hex), 245 (decimal)

## Instance IDs

The TCP/IP interface object presents 2 instance values:

- 0: class
- 1: instance

## Attributes

TCP/IP interface object attributes are associated with each instance, as follows:

Instance ID = 0 (class attributes):

| Attribute ID | Description | GET | SET |
|---|---|---|---|
| 01 | Revision | X | — |
| 02 | Max Instance | X | — |
| X = supported<br>— = not supported | | | |

Instance ID = 1 (instance attributes):

| Attribute ID | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|
| 01 | Status | DWORD | X | — | 0x01 |
| 02 | Configuration Capability | DWORD | X | — | 0x01 = from BootP<br>0x11 = from flash<br>0x00 = other |
| 03 | Configuration Control | DWORD | X | X | 0x01 = out-of-box default |
| 04 | Physical Link Object | STRUCT | X | — | |
| | Path Size | UINT | | | |
| | Path | Padded EPATH | | | |
| X = supported<br>— = not supported | | | | | |

| Attribute ID | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|
| 05 | Interface Configuration | STRUCT | X | X | 0x00 = out-of-box default |
| | IP Address | UDINT | | | |
| | Network Mask | UDINT | | | |
| | Gateway Address | UDINT | | | |
| | Name Server | UDINT | | | |
| | Name Server 2 | UDINT | | | |
| | Domain Name | STRING | | | |
| 06 | Host Name | STRING | X | — | |
| X = supported<br>— = not supported | | | | | |

## Services

The TCP/IP interface object performs the following services upon the listed object types:

| Service ID | | Description | Class | Instance | Notes |
|---|---|---|---|---|---|
| hex | dec | | | | |
| 01 | 01 | Get_Attributes_All | X | X | Returns the value of all attributes. |
| 0E | 14 | Get_Attribute_Single | X | X | Returns the value of the specified attribute. |
| 10 | 16 | Set_Attribute_Single[1] | — | X | Sets the value of the specified attribute. |
| X = supported<br>— = not supported | | | | | |

1. The Set_Attribute_Single service can execute only when these preconditions are satisfied:
- Configure the Ethernet communication module to obtain its IP address from flash memory.
- Confirm that the PLC is in stop mode.

# Ethernet Link Object

## Overview

The Ethernet Link object consists of the instances, attributes and services described below.

## Class ID

F6 (hex), 246 (decimal)

## Instance IDs

The Ethernet Link object presents the following instance values:

- 0: class
- 1: port 1
- 2: port 2
- 3: port 3
- 4: port 4
- 5: internal port

## Attributes

The Ethernet Link object presents the following attributes:

Instance ID = 0 (class attributes):

| Attribute ID | Description | GET | SET |
|---|---|---|---|
| 01 | Revision | X | — |
| 02 | Max Instance | X | — |
| 03 | Number of Instances | X | — |
| X = supported<br>— = not supported | | | |

Instance ID = 1...5 (instance attributes):

| Attribute ID | | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|---|
| hex | dec | | | | | |
| 01 | 01 | Interface Speed | UDINT | X | — | Valid values include:<br>0, 10000000, 100000000 |
| X = supported<br>— = not supported | | | | | | |

| Attribute ID | | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|---|
| **hex** | **dec** | | | | | |
| 02 | 02 | Interface Flags | DWORD | X | — | Bit 0: Link Status<br>0 = Inactive<br>1 = Active |
| | | | | | | Bit 1: Duplex Mode<br>0 = half duplex<br>1 = full duplex |
| | | | | | | Bits 2—4: Negotiation Status<br>3 = successfully negotiated speed and duplex<br>4 = forced speed and link |
| | | | | | | Bit 5: Manual Setting Requires Reset<br>0 = automatic<br>1 = device need reset |
| | | | | | | Bit 6: Local Hardware Fault detected<br>0 = no event<br>1 = event detected |
| 03 | 03 | Physical Address | ARRAY of 6 USINT | X | — | Module MAC Address |
| X = supported<br>— = not supported | | | | | | |

| Attribute ID | | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|---|
| **hex** | **dec** | | | | | |
| 04 | 04 | Interface Counters | STRUCT | X | — | |
| | | In octets | UDINT | | | Octets received on the interface |
| | | In Ucast Packets | UDINT | | | Unicast packets received on the interface |
| | | In NUcast Packets | UDINT | | | Non-unicast packets received on the interface |
| | | In Discards | UDINT | | | Inbound packets received on the interface, but discarded |
| | | In Errors | UDINT | | | Inbound packets that contain detected errors (does not include In Discards) |
| | | In Unknown Protos | UDINT | | | Inbound packets with unknown protocol |
| | | Out Octets | UDINT | | | Octets sent on the interface |
| | | Out Ucast Packets | UDINT | | | Unicast packets sent on the interface |
| | | Out NUcast Packets | UDINT | | | Non-unicast packets sent on the interface |
| | | Out Discards | UDINT | | | Outbound packets discarded |
| | | Out Errors | UDINT | | | Outbound packets that contain detected errors |
| X = supported<br>— = not supported | | | | | | |

| Attribute ID | | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|---|
| hex | dec | | | | | |
| 05 | 05 | Media Counters | STRUCT | X | — | |
| | | Alignment Errors | UDINT | | | Frames that are not an integral number of octets in length |
| | | FCS Errors | UDINT | | | CRC error detected—Frames received with a dtected FCS checksum error |
| | | Single Collisions | UDINT | | | Successfully transmitted frames that experienced exactly one collision |
| | | Multiple Collisions | UDINT | | | Successfully transmitted frames that experienced more than one collision |
| | | SQE Test Errors | UDINT | | | Number of times the SQE test error is detected |
| | | Deferred Transmissions | UDINT | | | Frames for which first transmission attempt is delayed because the medium is busy |
| | | Late Collisions | UDINT | | | Number of times a collision is detected later than 512 bittimes into the transmission of a packet |
| | | Excessive Collisions | UDINT | | | Frames for which transmission is not successful due to excessive collisions |
| | | MAC Transmit Errors | UDINT | | | Frames for which transmission is not successful due to internal MAC sublayer transmit detected error |
| | | Carrier Sense Errors | UDINT | | | Times that the carrier sense condition was lost or not asserted when attempting to transmit a frame |
| | | Frame Too Long | UDINT | | | Frames received that exceed the maximum permitted frame size |
| | | MAC Receive Errors | UDINT | | | Frames for which reception on an interface is not successful due to an internal MAC sublayer receive detected error |
| X = supported<br>— = not supported | | | | | | |

| Attribute ID | | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|---|
| hex | dec | | | | | |
| 06 | 06 | Interface Control | STRUCT | X | X | API of the connection |
| | | Control Bits | WORD | | | Bit 0: Auto-negotiation<br>0 = Disabled<br>1 = Enabled<br>**Note:** When auto-negotiation is enabled, the detected error 0x0C (Object State Conflict) is returned when attempting to set either:<br>● Forced Interface Speed, or<br>● Forced Duplex Mode |
| | | | | | | Bit 1: Forced Duplex Mode (if auto-negotiation bit = 0)<br>0 = half duplex<br>1 = full duplex |
| | | Forced Interface Speed | UINT | | | Valid values include:<br>10000000, 100000000<br>**Note:** Attempting to set any other value returns the detected error 0x09 (Invalid Attribute Value) |
| 10 | 16 | Interface Label | SHORT_STRING | X | — | A fixed textual string identifying the interface, that should include 'internal' for internal interfaces. Maximum number of characters is 64. |
| X = supported<br>— = not supported | | | | | | |

## Services

The Ethernet Link object performs the following services upon the listed object types:

| Service ID | | Description | Class | Instance |
|---|---|---|---|---|
| hex | dec | | | |
| 01 | 01 | Get_Attributes_All | X | X |
| 10 | 16 | Set_Attribute_Single | — | X |
| 0E | 14 | Get_Attribute_Single | X | X |
| 4C | 76 | Get_and_Clear | — | X |
| X = supported<br>— = not supported | | | | |

# EtherNet/IP Interface Diagnostics Object

## Overview

The EtherNet/IP Interface Diagnostics object presents the instances, attributes and services described below.

## Class ID

350 (hex), 848 (decimal)

## Instance IDs

The EtherNetP/IP Interface object presents two instance values:

- 0: class
- 1: instance

## Attributes

EtherNet/IP Interface Diagnostics object attributes are associated with each instance, as follows:

Instance ID = 0 (class attributes):

| Attribute ID | Description | GET | SET |
|---|---|---|---|
| 01 | Revision | X | — |
| 02 | Max Instance | X | — |
| X = supported<br>— = not supported | | | |

Instance ID = 1 (instance attributes):

| Attribute ID | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|
| 01 | Protocols Supported | UINT | X | — | |
| 02 | Connection Diagnostics | STRUCT | X | — | |
| | Max CIP IO Connections opened | UINT | | | Number of Class 1 connections opened since the last reset |
| | Current CIP IO Connections | UINT | | | Number of Class 1 connections currently opened |
| | Max CIP Explicit Connections opened | UINT | | | Number of Class 3 connections opened since the last reset |
| | Current CIP Explicit Connections | UINT | | | Number of Class 3 connections currently opened |
| | CIP Connections Opening Errors | UINT | | | Increments each time a Forward Open is not successful (Originator and Target) |
| | CIP Connections Timeout Errors | UINT | | | Increments when a connection times out (Originator and Target) |
| | Max EIP TCP Connections opened | UINT | | | Number of TCP connections (used for EIP, as client or server) opened since the last reset |
| | Current EIP TCP Connections | UINT | | | Number of TCP connections (used for EIP, as client or server) currently open |
| 03 | IO Messaging Diagnostics | STRUCT | X | X | |
| | IO Production Counter | UDINT | | | Increments each time a Class 0/1 message is sent |
| | IO Consumption Counter | UDINT | | | Increments each time a Class 0/1 message is received |
| | IO Production Send Errors Counter | UINT | | | Increments each time a Class 0/1 message is not sent |
| | IO Consumption Receive Errors Counter | UINT | | | Increments each time a consumption is received with a detected error |
| X = supported<br>— = not supported | | | | | |

| Attribute ID | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|
| 04 | Explicit Messaging Diagnostics | STRUCT | X | X | |
| | Class 3 Msg Send Counter | UDINT | | | Increments each time a Class 3 message is sent (client and server) |
| | Class 3 Msg Receive Counter | UDINT | | | Increments each time a Class 3 message is received (client and server) |
| | UCMM Msg Receive Counter | UDINT | | | Increments each time a UCMM message is sent (client and server) |
| | UCMM Msg Receive Counter | UDINT | | | Increments each time a UCMM message is received (client and server) |
| X = supported<br>— = not supported | | | | | |

## Services

The EtherNet/IP Interface Diagnostics object performs the following services upon the listed object types:

| Service ID | | Description | Class | Instance | Notes |
|---|---|---|---|---|---|
| hex | dec | | | | |
| 01 | 01 | Get_Attributes_All | X | X | Returns the value of all attributes. |
| 0E | 14 | Get_Attribute_Single | — | X | Returns the value of the specified attribute. |
| 4C | 76 | Get_and_Clear | — | X | Returns and clears the values of all instance attributes. |
| X = supported<br>— = not supported | | | | | |

# EtherNet/IP IO Scanner Diagnostics Object

## Overview

The EtherNet/IP IO Scanner Diagnostics object presents the instances, attributes and services described below.

## Class ID

351 (hex), 849 (decimal)

## Instance IDs

The EtherNet/IP IO Scanner Diagnostics object presents two instances:

- 0: class
- 1: instance

## Attributes

EtherNet/IP IO Scanner Diagnostics object attributes are associated with each instance, as follows:

Instance ID = 0 (class attributes):

| Attribute ID | Description | GET | SET |
|---|---|---|---|
| 01 | Revision | X | — |
| 02 | Max Instance | X | — |
| X = supported<br>— = not supported | | | |

Instance ID = 1 (instance attributes):

| Attribute ID | Description | Type | GET | SET |
|---|---|---|---|---|
| 01 | IO Status Table | STRUCT | X | — |
| | Size | UINT | | |
| | Status | ARRAY of UINT | | |
| X = supported<br>— = not supported | | | | |

## Services

The EtherNet/IP IO Scanner Diagnostics object performs the following services upon the listed object types:

| Service ID | | Description | Class | Instance | Notes |
|---|---|---|---|---|---|
| **hex** | **dec** | | | | |
| 01 | 01 | Get_Attributes_All | X | X | Returns the value of all attributes. |
| 0E | 14 | Get_Attribute_Single | X | X | Returns the value of the specified attribute. |
| X = supported<br>— = not supported | | | | | |

# IO Connection Diagnostics Object

## Overview

The IO Connection Diagnostics object presents the instances, attributes and services described below.

## Class ID

352 (hex), 850 (decimal)

## Instance IDs

The IO Connection Diagnostics object presents two instance values:

- 0: class
- 1...256: instance (The instance number is the connection number in the configuration.)

## Attributes

IO Connection Diagnostics object attributes are associated with each instance, as follows:

Instance ID = 0 (class attributes):

| Attribute ID | Description | GET | SET |
|---|---|---|---|
| 01 | Revision | X | — |
| 02 | Max Instance | X | — |
| X = supported<br>— = not supported | | | |

Instance ID = 1 to 256 (instance attributes):

| Attribute ID | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|
| 01 | IO Communication Diagnostics | STRUCT | X | X | |
| | IO Production Counter | UDINT | | | Increments at each production |
| | IO Consumption Counter | UDINT | | | Increments at each consumption |
| | IO Production Send Errors Counter | UINT | | | Increments each time a production is not sent |
| | IO Consumption Receive Errors Counter | UINT | | | Increments each time a consumption is received with a detected error |
| | CIP Connection Timeout Errors | UINT | | | Increments when a connection times out |
| | CIP Connection Opening Errors | UINT | | | Increments each time a connection is unable to open |
| | CIP Connection State | UINT | | | State of the Connection Bit |
| | CIP Last Error General Status | UINT | | | General status of the last error detected on the connection |
| | CIP Last Error Extended Status | UINT | | | Extended status of the last error detected on the connection |
| | Input Communication Status | UINT | | | Communication status of the inputs (see table, below) |
| | Output Communication Status | UINT | | | Communication status of the outputs (see table, below) |
| X = supported<br>— = not supported | | | | | |

| Attribute ID | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|
| 02 | Connection Diagnostics | STRUCT | X | X | |
| | Production Connection ID | UDINT | | | Connection ID for production |
| | Consumption Connection ID | UDINT | | | Connection ID for consumption |
| | Production RPI | UDINT | | | RPI for production |
| | Production API | UDINT | | | API for production |
| | Consumption RPI | UDINT | | | RPI for consumption |
| | Consumption API | UDINT | | | API for consumption |
| | Production Connection Parameters | UDINT | | | Connection parameters for production |
| | Consumption Connection Parameters | UDINT | | | Connection parameters for consumption |
| | Local IP | UDINT | | | — |
| | Local UDP Port | UINT | | | — |
| | Remote IP | UDINT | | | — |
| | Remote UDP Port | UINT | | | — |
| | Production Multicast IP | UDINT | | | Multicast IP used for production (or 0) |
| | Consumption Multicast IP | UDINT | | | Multicast IP used for consumption (or 0) |
| | Protocols Supported | UDINT | | | Protocol supported on the connection:<br>1 = EtherNet/IP |
| X = supported<br>— = not supported | | | | | |

The following values describe the structure of the instance attributes: *CIP Connection State*, *Input Communication Status*, and *Output Communication Status*:

| Bit Number | Description | Values |
|---|---|---|
| 15...3 | *Reserved* | 0 |
| 2 | Idle | 0 = no idle notification<br>1 = idle notification |
| 1 | Consumption inhibited | 0 = consumption started<br>1 = no consumption |
| 0 | Production inhibited | 0 = production started<br>1 = no production |

## Services

The EtherNet/IP Interface Diagnostics object performs the following services upon the listed object types:

| Service ID | | Description | Class | Instance | Notes |
|---|---|---|---|---|---|
| **hex** | **dec** | | | | |
| 01 | 01 | Get_Attributes_All | X | X | Returns the value of all attributes. |
| 0E | 14 | Get_Attribute_Single | — | X | Returns the value of the specified attribute. |
| 4C | 76 | Get_and_Clear | — | X | Returns and clears the values of all instance attributes. |
| X = supported<br>— = not supported | | | | | |

# EtherNet/IP Explicit Connection Diagnostics Object

## Overview

The EtherNet/IP Explicit Connection Diagnostics object presents the instances, attributes and services described below.

## Class ID

353 (hex), 851 (decimal)

## Instance IDs

The EtherNet/IP Explicit Connection Diagnostics object presents two instance values:

- 0: class
- 1...*N*: instance (*N* = maximum concurrent number of diagnostic lists)

## Attributes

EtherNet/IP Explicit Connection Diagnostics object attributes are associated with each instance, as follows:

Instance ID = 0 (class attributes):

| Attribute ID hex | Description | Value | GET | SET |
|---|---|---|---|---|
| 01 | Revision | 1 | X | — |
| 02 | Max Instance | 0...N | X | — |
| X = supported<br>— = not supported | | | | |

Instance ID = 1 to *N* (instance attributes):

| Attribute ID hex | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|
| 01 | Originator connection ID | UDINT | X | — | Originator to target connection ID |
| 02 | Originator IP | UDINT | X | — | |
| 03 | Originator TCP Port | UINT | X | — | |
| 04 | Target connection ID | UDINT | X | — | Target to originator connection ID |
| 05 | Target IP | UDINT | X | — | |
| 06 | Target TCP Port | UINT | X | — | |
| X = supported<br>— = not supported | | | | | |

| Attribute ID hex | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|
| 06 | Msg Send Counter | UDINT | X | — | Incremented each time a Class 3 CIPMessage is sent on the connection |
| 07 | Msg Receive counter | UDINT | X | — | Increments each time a Class 3 CIP message is received on the connection |
| X = supported<br>— = not supported | | | | | |

## Services

The EtherNet/IP Explicit Connection Diagnostics object performs the following services upon the listed object type:

| Service ID | | Description | Class | Instance | Notes |
|---|---|---|---|---|---|
| hex | dec | | | | |
| 01 | 01 | Get_Attributes_All | X | X | Returns the value of all attributes. |
| X = supported<br>— = not supported | | | | | |

# EtherNet/IP Explicit Connection Diagnostics List Object

## Overview

The EtherNet/IP Explicit Connection Diagnostics List object presents the instances, attributes and services described below.

## Class ID

354 (hex), 852 (decimal)

## Instance IDs

The EtherNet/IP Explicit Connection Diagnostics List object presents two instance values:

- 0: class
- 1...*N*: instance

## Attributes

EtherNet/IP Explicit Connection Diagnostics List object attributes are associated with each instance, as follows:

Instance ID = 0 (class attributes):

| Attribute ID | Description | GET | SET |
|---|---|---|---|
| 01 | Revision | X | — |
| 02 | Max Instance | X | — |
| X = supported<br>— = not supported | | | |

Instance ID = 1 to *N* (instance attributes):

| Attribute ID | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|
| 01 | Number of connections | UINT | X | — | Total number of opened explicit connections |
| X = supported<br>— = not supported | | | | | |

| Attribute ID | Description | Type | GET | SET | Value |
|---|---|---|---|---|---|
| 02 | Explicit Messaging Connections Diagnostic List | ARRAY of STRUCT | X | — | |
| | Originator connection ID | UDINT | | | O->T connection ID |
| | Originator IP | UDINT | | | — |
| | Originator TCP port | UINT | | | — |
| | Target connection ID | UDINT | | | T->O connection ID |
| | Target IP | UDINT | | | — |
| | Target TCP port | UINT | | | — |
| | Msg Send counter | UDINT | | | Increments each time a Class 3 CIP message is sent on the connection |
| | Msg Receive counter | UDINT | | | Increments each time a Class 3 CIP message is received on the connection |
| X = supported<br>— = not supported | | | | | |

## Services

The EtherNet/IP Explicit Connection Diagnostics object performs the following services upon the listed object types:

| Service ID | | Description | Class | Instance | Notes |
|---|---|---|---|---|---|
| hex | dec | | | | |
| 01 | 01 | Get_Attributes_All | X | — | Returns the value of all attributes. |
| 08 | 08 | Create | X | — | — |
| 09 | 09 | Delete | — | X | — |
| 4B | 75 | Explicit_Connections_Diagnostic_Read | — | X | — |
| X = supported<br>— = not supported | | | | | |

# Chapter 7
# Online Action

## Overview

The Ethernet communication module supports online actions that let you:

- display CIP objects for the communication module or a remote EtherNet/IP device
- view and edit port configuration parameters for the communication module or a remote EtherNet/IP device
- ping the communication module or a remote EtherNet/IP or Modbus TCP device to confirm it is active on the Ethernet network
- connect to a remote device and then:
  - view the remote device's default parameter settings
  - view the remote device's current parameter settings
  - edit and download to the remote device its editable parameter settings

## What Is in This Chapter?

This chapter contains the following topics:


| Topic | Page |
|---|---|
| Accessing CIP Objects | 260 |
| Editing Port Configuration Properties for Remote EtherNet/IP Devices | 262 |
| Pinging a Network Device | 264 |
| Viewing and Editing Online Settings for a Remote Device | 266 |

# Accessing CIP Objects

## Overview

Use the **Module Information** page of the **Online Action** window to:

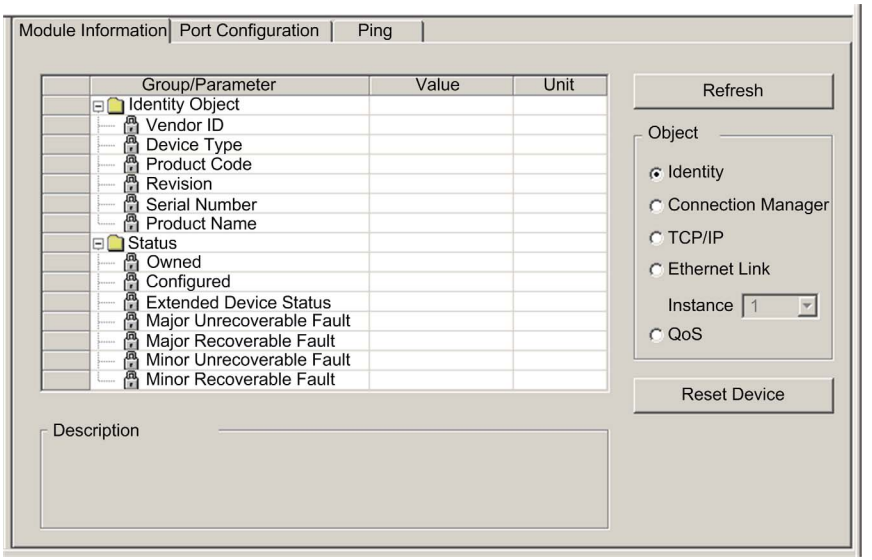
- retrieve and display current data describing the state of CIP objects for the selected communication module or remote EtherNet/IP device, and
- reset the selected communication module or remote EtherNet/IP device

**NOTE:** Before you can perform online actions for a communication module or remote device, connect its DTM to the physical module or device. To do this, select the module or device node in the **DTM Browser**, then select **Edit** →**Connect**.

The appearance of this page, and the CIP object information you can retrieve, depend upon the operating mode of the Unity Pro software:

| In this mode... | You can display data for these CIP objects... |
|---|---|
| Standard mode | Identity object *(see page 229)* |
| Advanced mode *(see page 47)* | • Identity object<br>• Connection Manager object *(see page 233)*<br>• TCP/IP Interface object *(see page 239)*<br>• Ethernet Link object<br>• QoS object *(see page 237)* |

The **Module Information** page looks like this:



## Retrieve and Display CIP Object Data

To display CIP object data for an EtherNet/IP communication module or remote device:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select a communication module. |
| 2 | Click the right mouse button, and in the pop-up menu select **Device menu** → **Online Action**. The **Online Action** window opens. |
| 3 | In the left pane of the **Online Action** window, select a communication module or EtherNet/IP device. |
| 4 | In the right pane, click on the **Module Information** tab to open that page. |
| 5 | If Unity Pro is operating in **Advanced Mode**<br>● Select one of the following CIP objects:<br>  ● Identity<br>  ● Connection Manager<br>  ● TCP/IP<br>  ● Ethernet Link<br>  ● QoS<br>● If you selected a multi-port module or device in step 3, above, select an **Interface**, or port, number<br>**NOTE:** If Unity Pro is operating in Standard Mode, it will display data only for the CIP Identity object. |
| 6 | Click the **Refresh** button to update the data displayed. |

## Reset a Communication Module or Remote EtherNet/IP Device

To reset a communication module or remote EtherNet/IP device:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select a communication module. |
| 2 | Click the right mouse button, and in the pop-up menu select **Device menu** → **Online Action**. The **Online Action** window opens. |
| 3 | In the left pane of the **Online Action** window, select a communication module or EtherNet/IP device. |
| 4 | In the right pane, click on the **Module Information** tab to open that page. |
| 5 | Click the **Reset Device** button. |

# Editing Port Configuration Properties for Remote EtherNet/IP Devices

## Overview

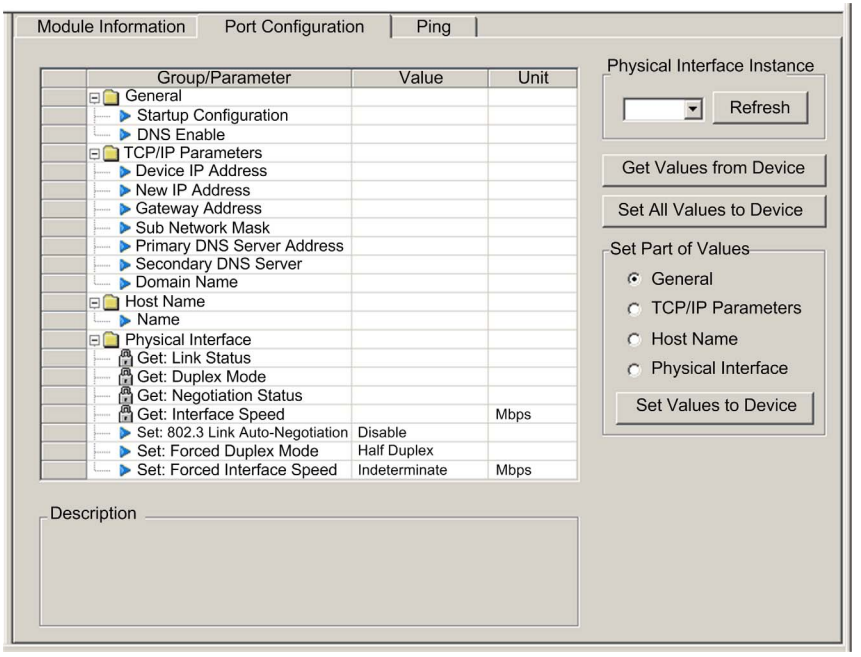
Use the **Port Configuration** page of the **Online Action** window to view and edit communication port properties for a remote EtherNet/IP device. Specifically, you can use this page to execute a:

- Get command to retrieve port configuration settings from a remote EtherNet/IP device
- Set command that writes all or selected edited values to the same remote EtherNet/IP device

Configuration edits transmitted from this page are sent as EtherNet/IP explicit messages and employ the **Address** and **Messaging** settings configured in the **EtherNet/IP Explicit Messaging** window.

**NOTE:** Before you can perform online actions for a remote device, connect its DTM to the physical device. To do this, select the device node in the **DTM Browser**, then select **Edit** →**Connect**.

The **Port Configuration** page looks like this:



## Get Port Configuration Settings

To get settings from a remote EtherNet/IP device on the network:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select the communication module upstream of the remote EtherNet/IP device. |
| 2 | Click the right mouse button, and in the pop-up menu select **Device menu** → **EtherNet/IP Explicit Message**. The **EtherNet/IP Explicit Message** window opens. |
| 3 | In the EtherNet/IP Explicit Messaging page, complete the **Address** section.<br>**Note**: Port configuration explicit messages are sent as unconnected messages. |
| 4 | Return to the **DTM Browser** and again select the communication module upstream of the remote EtherNet/IP device. |
| 5 | Click the right mouse button, and in the pop-up menu select **Device menu** → **Online Action**. The **Online Action** window opens. |
| 6 | In the left pane of the **Online Action** window, select a remote EtherNet/IP device. |
| 7 | In the right pane, click on the **Port Configuration** tab to open that page. |
| 8 | If the remote device consists of more than one port, select the port number in the **Physical Interface Instance** list. |
| 9 | In the **Port Configuration** page, click the **Get Values from Device** button.<br>The table displays the returned values of the communication properties for the selected remote device and port. |

## Edit and Set Port Configuration Settings

To edit and set port configuration settings that were retrieved using the above-described **Get Port Configuration Settings** process:

| Step | Action |
|---|---|
| 1 | Double-click the left mouse button in the **Value** cell for the parameter you want to edit. The cell becomes editable.<br>**Note:** The page also displays a **Description** of the selected parameter. |
| 2 | Type in, or select, the new value. |
| 3 | Repeat steps 1 - 2 for each parameter you want to edit. |
| 4 | Do one of the following:<br>● Click the **Set All Values to Device** to write every value to the remote device<br>- or -<br>● if you edited parameters for only one part, or group, of the collection of remote device values, then:<br>  ● in the **Set Part of Values** area, select one property group, then<br>  ● click the **Set Values to Device** button<br>Unity Pro sends the property value edits to the remote device via an EtherNet/IP explicit message, and displays the results in the **Description** area. |

# Pinging a Network Device

## Overview

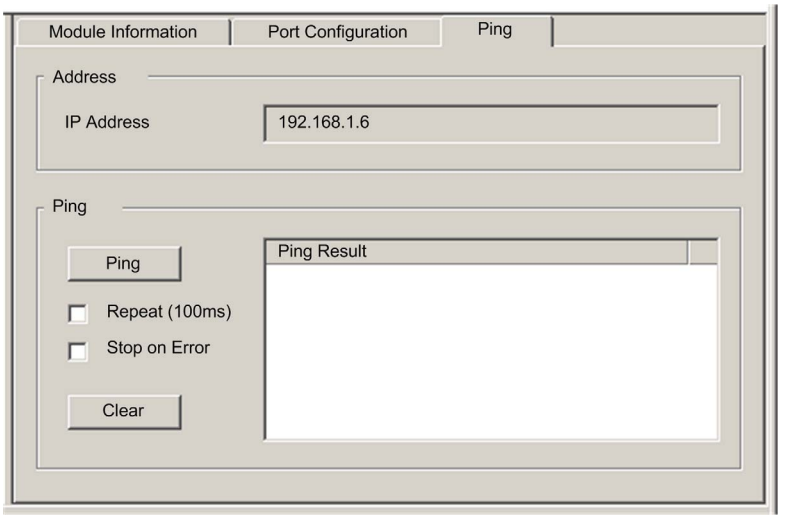
Use the Unity Pro ping function to send an ICMP echo request to a target Ethernet device to determine:

- if the target device is present, and if so
- the elapsed time to receive an echo response from the target device

The target device is identified by its IP address setting. Unity Pro will verify that the target address is not a:

- loopback address (127.000.000.000 to 127.255.255.255)
- multicast address (224.000.000.000 to 239.255.255.255)
- reserved address (240.000.000.000 to 255.255.255.255)
- broadcast address

The ping function can be performed in the **Ping** page of the **Online Action** window:



## Pinging a Network Device

To ping a network device:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select the communication module upstream of the remote EtherNet/IP device you want to ping. |
| 2 | Click the right mouse button and select **Device Menu >** →**Online Action** in the pop-up menu. The **Online Action** window opens. |
| 3 | In the **Online Action** window, select the device you want to ping. The window displays pages containing online information for the selected device.<br>**NOTE:** The specific collection of displayed pages depends on the type of device selected:<br>● the communication module<br>● a remote EtherNet/IP device<br>● a remote Modbus TCP device |
| 4 | Select the **Ping** page. To send...<br>● a single ping, de-select the **Repeat** checkbox<br>● a series of pings—1 every 100 ms—select **Repeat** checkbox |
| 5 | (Optional) Select **Stop on Error** to stop pinging an unsuccessful communication. |
| 6 | Click **Ping** once to begin pinging. |
| 7 | Click **Ping** a second time to stop repeated pinging, where no error has been detected. |
| 8 | The **Ping Result** box displays the ping outcome. Click **Clear** to empty the **Ping Result** box. |

# Viewing and Editing Online Settings for a Remote Device

## Introduction

Use the **Online Parameters** window to:

- view the remote device's default parameter settings
- view the remote device's current parameter settings
- edit and download to the remote device its editable parameter settings

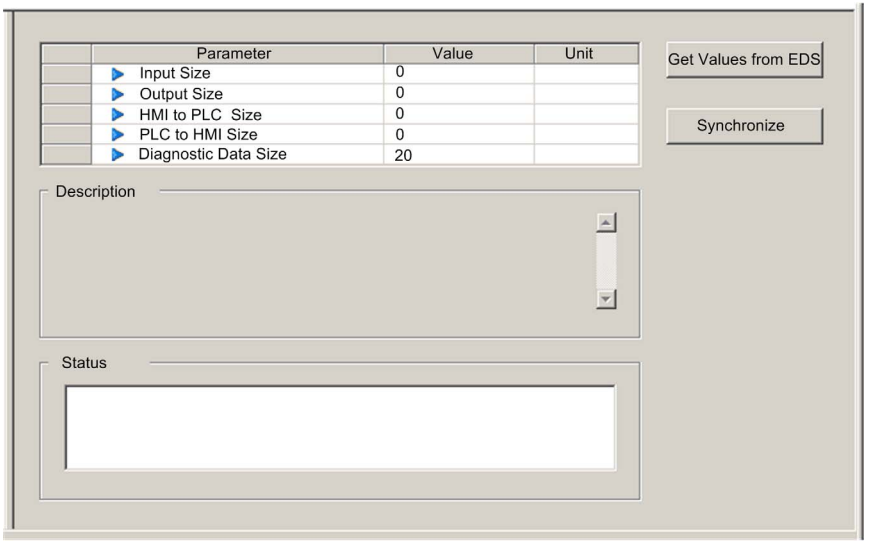
Parameter setting edits transmitted from this page are sent as EtherNet/IP explicit messages and employ the **Address** and **Messaging** settings configured in the **EtherNet/IP Explicit Messaging** window.

**NOTE:** Before you can view and edit online settings for a remote device, connect its DTM file to the physical device. To do this, select the device node in the **DTM Browser**, then select **Edit** → **Connect**.

To open the **Online Parameters** window, follow these steps:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select the node for a remote device. |
| 2 | Click the right mouse button, and in the pop-up menu select **Device menu** → **Online Parameters**. The **Online Parameters** window opens for the selected remote device. |
| 3 | In the left pane of the **Online Parameters** window, select a connection node. Unity Pro displays the parameters relating to the selected connection in the right pane.<br>**NOTE:** The list of parameters displayed in the **Online Parameters** window depends upon:<br>● the device selected in the **DTM Browser**, and<br>● the connection selected in the left pane of the **Online Parameters** window |

An example of the **Online Parameters** window—in this case for the STB NIC 2212 remote network interface device—looks like this:




Read-only parameters are identified by a locked icon .

Editable parameters are identified by a blue arrowhead .

## Displaying Default Parameter Settings

To view the default parameter settings for the remote device, click the **Get Values from EDS** button. Unity Pro reads the default device values from its EDS file and displays them on-screen.

## Displaying Online Parameter Settings

To view the current parameter settings for the remote device, follow these steps:

| Step | Action |
|---|---|
| 1 | With a connection selected in the left pane, click the **Synchronize** button. The **Synchronize Action** message box opens. |
| 2 | In the message box, select **Read values from the device**, then click **OK**. The message box closes. In the **Online Parameters** window:<br>● the **Status** field displays the results of the read transaction<br>● the parameter list displays current values |

## Editing Online Parameter Settings

To edit parameter settings for the remote device, follow these steps:

| Step | Action |
|---|---|
| 1 | With a connection selected in the left pane, display either:<br>● default device settings, or<br>● current device settings |
| 2 | In the **Value** column, type in or select a new value for each setting you want to edit.<br>**NOTE:** When you select a parameter, the **Description** area displays an explanation of the parameter and its available settings. |
| 3 | Click the **Synchronize** button. The **Synchronize Action** message box opens. |
| 4 | In the message box, select **Write data to the device**, then click **OK**.<br>The message box closes. In the **Online Parameters** window, the **Status** field displays the results of the write transaction. |

# Chapter 8
# Explicit Messaging

## Overview

The BMX NOC 0401 Ethernet communication module supports explicit messaging by means of both the EtherNet/IP and Modbus TCP protocols.

To create an explicit message for the EtherNet/IP protocol, use the DATA_EXCH function block in application logic.

To create an explicit message for the Modbus TCP protocol, use any one of the following function blocks in application logic: DATA_EXCH, READ_VAR, or WRITE_VAR.

**NOTE:** A single Unity Pro application can contain more than 16 explicit messaging blocks, but only 16 explicit messaging blocks can be active at the same time.

This chapter describes how to configure both EtherNet/IP and Modbus TCP explicit messages by using:

- the DATA_EXCH function block in application logic
- the Unity Pro graphical user interface

## What Is in This Chapter?

This chapter contains the following sections:


| Section | Topic | Page |
|---|---|---|
| 8.1 | Explicit Messaging Using the DATA_EXCH Block | 270 |
| 8.2 | EtherNet/IP Explicit Messaging Using DATA_EXCH | 274 |
| 8.3 | Modbus TCP Explicit Messaging Using DATA_EXCH | 291 |
| 8.4 | Explicit Messaging via the Unity Pro GUI | 299 |

# Section 8.1
## Explicit Messaging Using the DATA_EXCH Block

### Overview

This section introduces you to the DATA_EXCH function block, which you can use to configure both EtherNet/IP and Modbus TCP explicit messages.

This section describes how to configure the DATA_EXCH function block's Management parameter, which is common to both Modbus TCP and EtherNet/IP explicit messaging.

### What Is in This Section?

This section contains the following topics:


| Topic | Page |
|---|---|
| Configuring Explicit Messaging Using DATA_EXCH | 271 |
| Configuring the DATA_EXCH Management Parameter | 273 |

# Configuring Explicit Messaging Using DATA_EXCH

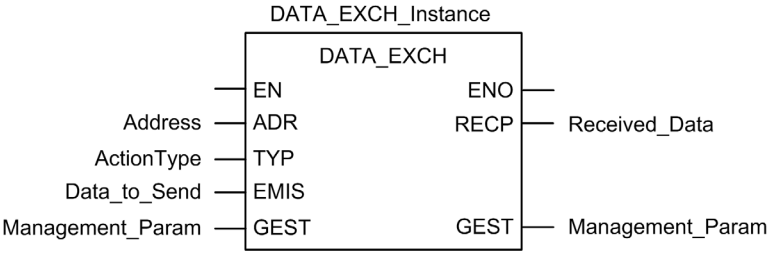
## Overview

Use the DATA_EXCH function block to configure both Modbus TCP explicit messages and connected and unconnected EtherNet/IP explicit messages.

The Management_Param, the Data_to_Send, and the Received_Data parameters define the operation.

EN and ENO can be configured as additional parameters.

## FBD Representation




## Input Parameters

| Parameter | Data type | Description |
|---|---|---|
| Address | Array [0...7] of INT | The path to the destination device, the content of which can vary depending on the message protocol. Use the ADDM function. Refer to a description of the Address parameter for:<br>● EtherNet/IP messages *(see page 277)*<br>● Modbus TCP messages *(see page 293)* |
| ActionType | INT | The type of action to perform. For both the EtherNet/IP and Modbus TCP protocols, this setting = 1 (transmission followed by await reception). |
| Data_to_Send | Array [n...m] of INT | The content of this parameter is specific to the protocol, either EtherNet/IP or Modbus TCP.<br>For EtherNet/IP explicit messaging, refer to the to the topic Configuring the Data_To_Send Parameter *(see page 277)*.<br>For Modbus TCP explicit messaging, refer to Unity Pro online help. |

## Input/Output Parameters

| Parameter | Data type | Description |
|---|---|---|
| `Management_Param` | Array [0...3] of `INT` | The management parameter *(see page 273)*, consisting of 4 words. |

## Output Parameters

| Parameter | Data type | Description |
|---|---|---|
| `Received_Data` | Array [n...m] of `INT` | The EtherNet/IP (CIP) response *(see page 278)* or the Modbus TCP response *(see page 294)*.<br>The structure and content depends upon the specific protocol. |

# Configuring the DATA_EXCH Management Parameter

## Introduction

The structure and content of the management parameter of the `DATA_EXCH` block is common to both EtherNet/IP and Modbus TCP explicit messaging.

## Configuring the Management Parameter

The management parameter consists of 4 contiguous words, described below:

| Data source | Register | Description | |
|---|---|---|---|
| | | **High Byte (MSB)** | **Low Byte (LSB)** |
| Data managed by the system | `Management_Param[0]` | Exchange number | Two read-only bits:<br>● Bit 0 = Activity bit (see below)<br>● Bit 1 = Cancel bit |
| | `Management_Param[1]` | Operation report *(see page 396)* | Communication report *(see page 395)* |
| Data managed by the user | `Management_Param[2]` | Block timeout. Values include:<br>● 0 = infinite wait<br>● other values = timeout x 100 ms, for example:<br>  ● 1 = 100 ms<br>  ● 2 = 200 ms | |
| | `Management_Param[3]` | Length of data sent or received:<br>● Input (before sending the request): length of data in the `Data_to_Send` parameter, in bytes<br>● Output (after response): length of data in the `Received_Data` parameter, in bytes | |

**Activity Bit:**

This bit indicates the execution status of the communication function.

It is set to 1 when launched, and returns to 0 when its execution is complete.

It is the first bit of the first element of the table.

**Example:** if the management table has been declared as follows:

```
Management_Param[0] ARRAY [0..3] OF INT,
```

the activity bit is the bit with the notation `Management_Param[0].0`.

**NOTE:** The notation previously used requires configuration of the project properties in such a way as to authorize the extraction of bits on integer types. If this is not the case, `Management_Param[0].0` cannot be accessed in this manner.

# Section 8.2
# EtherNet/IP Explicit Messaging Using DATA_EXCH

## Overview

This section shows you how to configure the `DATA_EXCH` function block for EtherNet/IP explicit messages.

## What Is in This Section?

This section contains the following topics:


| Topic | Page |
|---|---|
| Explicit Messaging Services | 275 |
| Configuring EtherNet/IP Explicit Messaging Using DATA_EXCH | 277 |
| EtherNet/IP Explicit Message Example: Get_Attribute_Single | 279 |
| EtherNet/IP Explicit Message Example: Read Modbus Object | 283 |
| EtherNet/IP Explicit Message Example: Write Modbus Object | 287 |

# Explicit Messaging Services

## Overview

Every explicit message performs a service. Each service is associated with a service code (or number). You will need to identify the explicit messaging service by its name, decimal number, or hexadecimal number.

You can execute explicit messages using either the `DATA_EXCH` function block in Unity Pro, or the Unity Pro Ethernet Configuration Tool.

## Services

The services available in Unity Pro include, but are not limited to, the services listed below:

| Service Code | | Description | Available in... | |
|---|---|---|---|---|
| **Hex** | **Dec** | | **DATA_EXCH block** | **Unity Pro GUI** |
| 0 | 0 | (*Reserved*) | — | — |
| 1 | 1 | Get_Attributes_All | X | X |
| 2 | 2 | Set_Attributes_All | X | X |
| 3 | 3 | Get_Attribute_List | X | — |
| 4 | 4 | Set_Attribute_List | X | — |
| 5 | 5 | Reset | X | X |
| 6 | 6 | Start | X | X |
| 7 | 7 | Stop | X | X |
| 8 | 8 | Create | X | X |
| 9 | 9 | Delete | X | X |
| A | 10 | Multiple_Service_Packet | X | — |
| B-C | 11-12 | (*Reserved*) | — | — |
| D | 13 | Apply_Attributes | X | X |
| E | 14 | Get_Attribute_Single | X | X |
| F | 15 | (*Reserved*) | — | — |
| 10 | 16 | Set_Attribute_Single | X | X |
| 11 | 17 | Find_Next_Object_Instance | X | X |
| 12-13 | 18-19 | (*Reserved*) | — | — |
| 14 | 20 | Error Response (DeviceNet only) | — | — |
| 15 | 21 | Restore | X | X |
| 16 | 22 | Save | X | X |
| "X" indicates the service is available. "—" indicates the service is not available. | | | | |

| Service Code | | Description | Available in... | |
|---|---|---|---|---|
| **Hex** | **Dec** | | **DATA_EXCH block** | **Unity Pro GUI** |
| 17 | 23 | No Operation (NOP) | X | X |
| 18 | 24 | Get_Member | X | X |
| 19 | 25 | Set_Member | X | X |
| 1A | 26 | Insert_Member | X | X |
| 1B | 27 | Remove_Member | X | X |
| 1C | 28 | GroupSync | X | — |
| 1D-31 | 29-49 | (*Reserved*) | — | — |
| "X" indicates the service is available. "—" indicates the service is not available. | | | | |

# Configuring EtherNet/IP Explicit Messaging Using DATA_EXCH

## Configuring the Address Parameter

To configure the Address parameter, use the `ADDM` function to convert the character string, described below, to an address:

ADDM('rack.slot.channel{ip_address}message_type.protocol'), where:

| This field... | Represents... |
|---|---|
| rack | the number assigned to the rack containing the communication module |
| slot | the position of the communication module in the rack |
| channel | the communication channel—set to a value of **0** |
| ip_address | the IP address of the remote device, for example 193.168.1.6 |
| message_type | the type of message, presented as a three character string—either:<br>• **UNC** (indicating an unconnected message), or<br>• **CON** (indicating a connected message) |
| protocol | the protocol type—the three character string **CIP** |

## Configuring the Data_to_Send Parameter

The `Data_to_Send` parameter varies in size. It consists of contiguous registers that include—in sequence—both the message type and the CIP request:

| Offset (words) | Length (bytes) | Data Type | Description |
|---|---|---|---|
| 0 | 2 bytes | Bytes | Message type:<br>• High byte = size of the request in words<br>• Low byte = EtherNet/IP service code |
| 1 | `Management_Param[3]` (size of `Data_to_Send`) minus 2 | Bytes | The CIP request[1].<br>**NOTE:** The structure and size of the CIP request depends on the EtherNet/IP service. |
| **1** Structure the CIP request in little endian order. | | | |

### Contents of the Received_Data Parameter

The `Received_Data` parameter contains only the CIP response. The length of the CIP response varies, and is reported by `Management_Param[3]` after the response is received. The format of the CIP response is described, below:

| Offset (words) | Length (bytes) | Data Type | Description |
|---|---|---|---|
| 0 | 2 | Byte | ● High byte (MSB) = reserved<br>● Low byte (LSB): reply service |
| 1 | 2 | Byte | ● High byte (MSB): length of additional status<br>● Low byte (LSB): EtherNet/IP general status *(see page 399)* |
| 2 | length of additional status | Byte array | Additional Status[1] |
| ... | `Management_Param[3]` (size of `Received_Data`) minus 4, and minus the additional status length | Byte array | Response data |
| 1. Refer to *The CIP Networks Library, Volume 1, Common Industrial Protocol* at section 3-5.6 *Connection Manager Object Instance Error Codes*. | | | |

**NOTE:** The response is structured in little endian order.

### Checking the Received_Data Response for System and CIP Status

Use the contents of the Received_Data parameter to check both the system status and the CIP status of the Ethernet communication module when handling the explicit message.

**First:** Check the value of the high byte (MSB) of the first response word, positioned at offset 0. If the value of this byte is:

- equal to 0: the system properly handled the explicit message
- not equal to 0: a system-based event occurred
  Refer to the list of EtherNet/IP Explicit Messaging Event Codes *(see page 392)* for an explanation of the system-based event code contained in the second response word, positioned at offset 1.

**Next:** If the system properly handled the explicit message, and the high byte of the first response word equals 0, check the value of the second response word, positioned at offset 1. If the value of this word is:

- equal to 0: the explicit message was properly handled by the CIP protocol
- not equal to 0: a CIP protocol-based event occurred
  Refer to your CIP documentation for an explanation of the CIP status displayed in this word.

# EtherNet/IP Explicit Message Example: Get_Attribute_Single

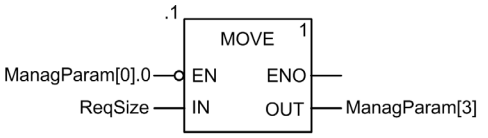
## Overview

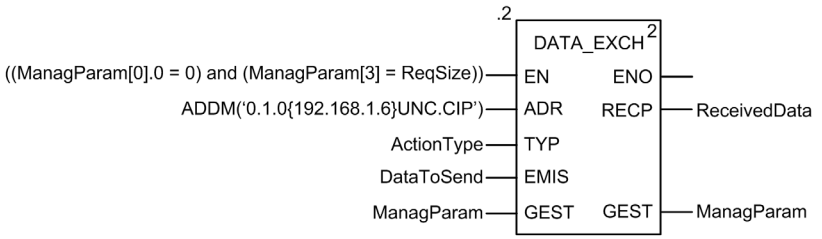
The following unconnected explicit messaging example shows you how to use the DATA_EXCH function block to retrieve diagnostic data from a remote device—in this case an STB NIC 2212 network interface module at IP address 192.168.1.6—using the Get_Attribute_Single service.

You can perform the same explicit messaging service using the **EtherNet/IP Explicit Message** window of the Unity Pro Ethernet Configuration Tool *(see page 300)*.

## Implementing the DATA_EXCH Function Block

To implement the DATA_EXCH function block, you need to create and assign variables for the following blocks:

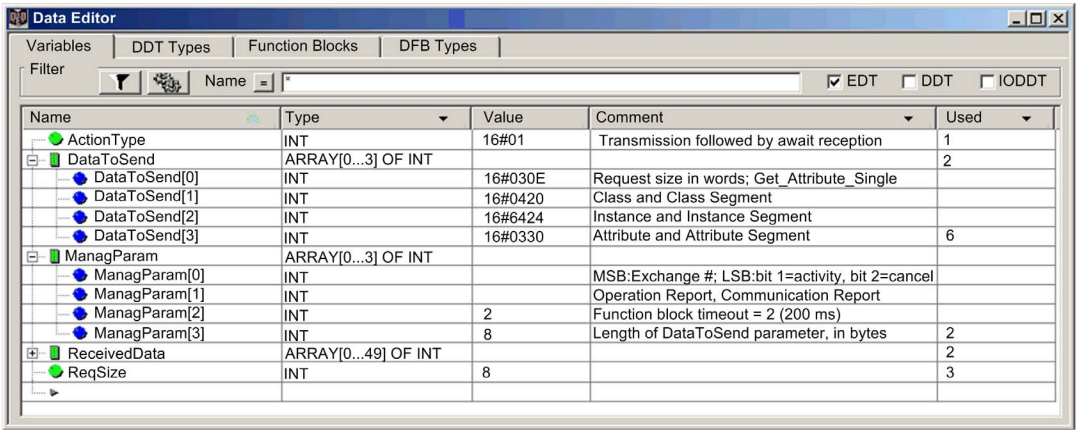


## Declaring Variables

In this example, the following variables were defined. You can, of course, use different variable names in your explicit messaging configurations.

In this example, the following variables were defined. You can, of course, use different variable names in your explicit messaging configurations.




| Name | Type | Value | Comment | Used |
|---|---|---|---|---|
| ActionType | INT | 16#01 | Transmission followed by await reception | 1 |
| DataToSend | ARRAY[0...3] OF INT | | | 2 |
| DataToSend[0] | INT | 16#030E | Request size in words; Get_Attribute_Single | |
| DataToSend[1] | INT | 16#0420 | Class and Class Segment | |
| DataToSend[2] | INT | 16#6424 | Instance and Instance Segment | |
| DataToSend[3] | INT | 16#0330 | Attribute and Attribute Segment | 6 |
| ManagParam | ARRAY[0...3] OF INT | | | |
| ManagParam[0] | INT | | MSB:Exchange #; LSB:bit 1=activity, bit 2=cancel | |
| ManagParam[1] | INT | | Operation Report, Communication Report | |
| ManagParam[2] | INT | 2 | Function block timeout = 2 (200 ms) | |
| ManagParam[3] | INT | 8 | Length of DataToSend parameter, in bytes | 2 |
| ReceivedData | ARRAY[0...49] OF INT | | | 2 |
| ReqSize | INT | 8 | | 3 |

## Configuring the Address Variable

The Address variable identifies the explicit message originating device (in this example, the communication module) and the target device. Note that the Address variable does not include the Xway address elements {Network.Station} because we are not bridging through another PLC station. Use the `ADDM` function to convert the following character string to an address:

`ADDM`('0.1.0{192.168.1.6}UNC.CIP'), where:

- rack = 0
- module (slot number) = 1
- channel = 0
- remote device IP address = 192.168.1.6
- message type = unconnected
- protocol = CIP

## Configuring the ActionType Variable

The ActionType variable identifies the function type for the `DATA_EXCH` function block:

| Variable | Description | Value (hex) |
|---|---|---|
| ActionType | Transmission followed by wait for response | 16#01 |

## Configuring the DataToSend Variable

The DataToSend variable identifies the type of explicit message and the CIP request:

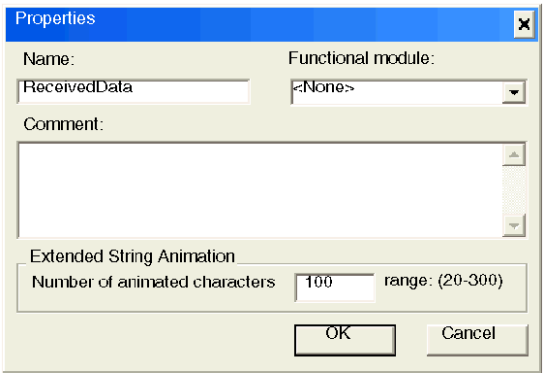
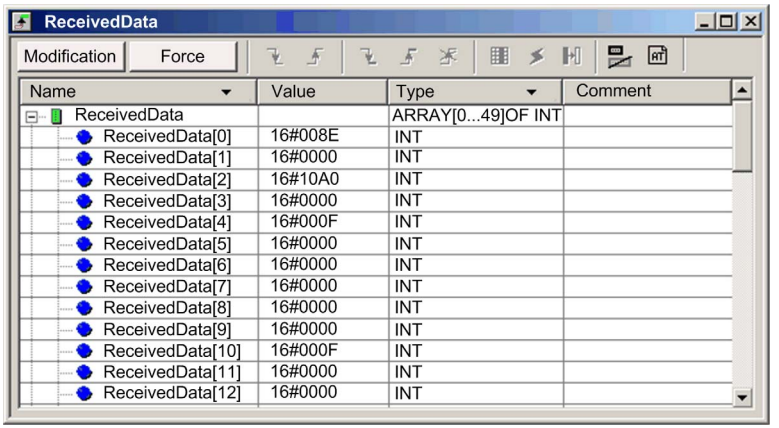
| Variable | Description | Value (hex) |
|---|---|---|
| DataToSend[0] | CIP request service information:<br>● High byte = request size in words: 16#03 (3 decimal)<br>● Low byte = service code: 16#0E (14 decimal) | 16#030E |
| DataToSend[1] | CIP request class information:<br>● High byte = class: 16#04 (4 decimal)<br>● Low byte = class segment: 16#20 (32 decimal) | 16#0420 |
| DataToSend[2] | CIP request instance information:<br>● High byte = instance: 16#64 (100 decimal)<br>● Low byte = instance segment: 16#24 (36 decimal) | 16#6424 |
| DataToSend[3] | CIP request attribute information:<br>● High byte = attribute: 16#03 (3 decimal)<br>● Low byte = attribute segment: 16#30 (48 decimal) | 16#0330 |

## Viewing the Response

Use a Unity Pro Animation table to display the ReceivedData variable array. Note that the ReceivedData variable array consists of the entire data buffer.

To display the CIP response, follow these steps:

| Step | Action | |
|---|---|---|
| 1 | In Unity Pro, select **Tools** →**Project Browser** to open the Project Browser. | |
| 2 | In the Project Browser, select the **Animation Tables** folder, then click the right mouse button. A pop-up menu appears. | |
| 3 | Select **New Animation Table** in the pop-up menu. A new animation table and its properties dialog both open. | |
| 4 | In the Properties dialog, edit the following values: | |
| | **Name** | Type in a table name. For this example: **ReceivedData**. |
| | **Functional module** | Accept the default **<None>**. |
| | **Comment** | (Optional) Type your comment here. |
| | **Number of animated characters** | Type in **100**, representing the size of the data buffer in words. |

| Step | Action |
|---|---|
| 5 | The completed **Properties** dialog looks like this:<br>  <br><br>Click **OK** to close the dialog. |
| 6 | In the animation table's **Name** column, type in the name of the variable assigned to the RECP pin: **ReceivedData** and hit **Enter**. The animation table displays the ReceivedData variable. |
| 7 | Expand the ReceivedData variable to display its word array, where you can view the CIP response contained in the ReceivedData variable:<br>  <br>ReceivedData<br>Modification Force<br>Name \| Value \| Type \| Comment<br>ReceivedData \| ARRAY[0...49]OF INT<br>ReceivedData[0] \| 16#008E \| INT<br>ReceivedData[1] \| 16#0000 \| INT<br>ReceivedData[2] \| 16#10A0 \| INT<br>ReceivedData[3] \| 16#0000 \| INT<br>ReceivedData[4] \| 16#000F \| INT<br>ReceivedData[5] \| 16#0000 \| INT<br>ReceivedData[6] \| 16#0000 \| INT<br>ReceivedData[7] \| 16#0000 \| INT<br>ReceivedData[8] \| 16#0000 \| INT<br>ReceivedData[9] \| 16#0000 \| INT<br>ReceivedData[10] \| 16#000F \| INT<br>ReceivedData[11] \| 16#0000 \| INT<br>ReceivedData[12] \| 16#0000 \| INT<br>**Note:** Each array entry presents 2 bytes of data in little endian format, where the least significant byte is stored in the smallest memory address. For example, '8E' in word[0] is the lower byte, and '00' is the upper byte. |

# EtherNet/IP Explicit Message Example: Read Modbus Object

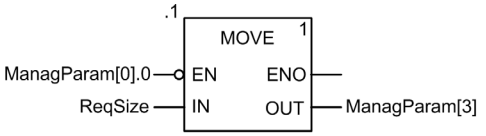
## Overview

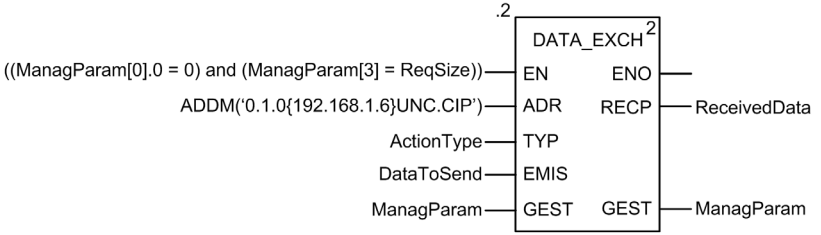
The following unconnected explicit messaging example shows you how to use the DATA_EXCH function block to read data from a remote device—in this case an STB NIC 2212 network interface module at IP address 192.168.1.6—using the Read_Holding_Registers service of the Modbus Object.

You can perform the same explicit messaging service using the **EtherNet/IP Explicit Message** window of the Unity Pro Ethernet Configuration Tool *(see page 300)*.

## Implementing the DATA_EXCH Function Block

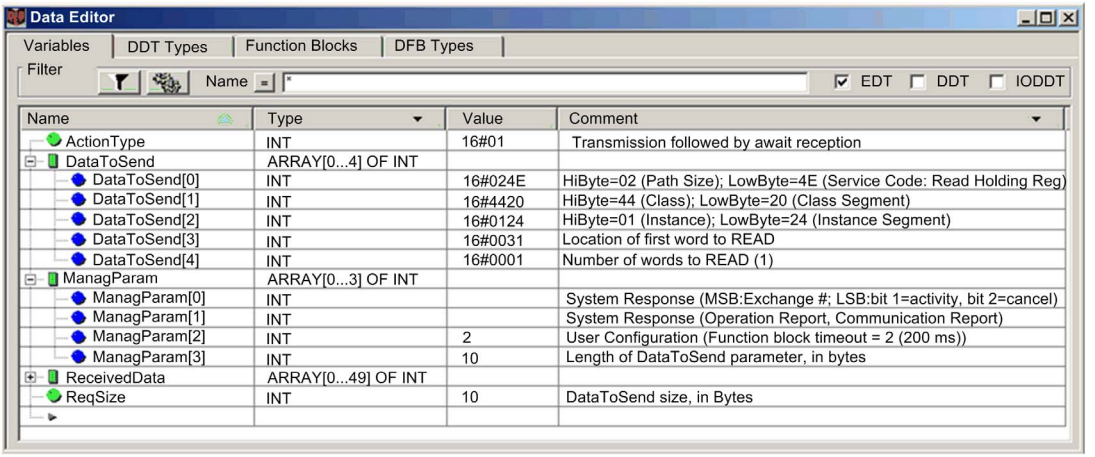
To implement the DATA_EXCH function block, you need to create and assign variables for the following blocks:



## Declaring Variables

In this example, the following variables were defined. You can, of course, use different variable names in your explicit messaging configurations.




| Name | Type | Value | Comment |
|---|---|---|---|
| ActionType | INT | 16#01 | Transmission followed by await reception |
| DataToSend | ARRAY[0...4] OF INT | | |
| DataToSend[0] | INT | 16#024E | HiByte=02 (Path Size); LowByte=4E (Service Code: Read Holding Reg) |
| DataToSend[1] | INT | 16#4420 | HiByte=44 (Class); LowByte=20 (Class Segment) |
| DataToSend[2] | INT | 16#0124 | HiByte=01 (Instance); LowByte=24 (Instance Segment) |
| DataToSend[3] | INT | 16#0031 | Location of first word to READ |
| DataToSend[4] | INT | 16#0001 | Number of words to READ (1) |
| ManagParam | ARRAY[0...3] OF INT | | |
| ManagParam[0] | INT | | System Response (MSB:Exchange #; LSB:bit 1=activity, bit 2=cancel) |
| ManagParam[1] | INT | | System Response (Operation Report, Communication Report) |
| ManagParam[2] | INT | 2 | User Configuration (Function block timeout = 2 (200 ms)) |
| ManagParam[3] | INT | 10 | Length of DataToSend parameter, in bytes |
| ReceivedData | ARRAY[0...49] OF INT | | |
| ReqSize | INT | 10 | DataToSend size, in Bytes |

## Configuring the Address Variable

The Address variable identifies the explicit message originating device (in this example, the Ethernet communication module) and the target device. Note that the Address variable does not include the Xway address elements {Network.Station} because we are not bridging through another PLC station. Use the `ADDM` function to convert the following character string to an address:

`ADDM`('0.1.0{192.168.1.6}UNC.CIP'), where:

- rack = 0
- module (slot number) = 1
- channel = 0
- remote device IP address = 192.168.1.6
- message type = unconnected
- protocol = CIP

## Configuring the ActionType Variable

The ActionType variable identifies the function type for the `DATA_EXCH` function block:

| Variable | Description | Value (hex) |
|---|---|---|
| ActionType | Transmission followed by wait for response | 16#01 |

## Configuring the DataToSend Variable

The DataToSend variable identifies the type of explicit message and the CIP request:

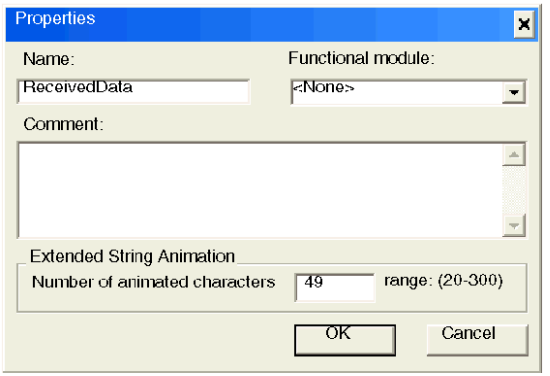
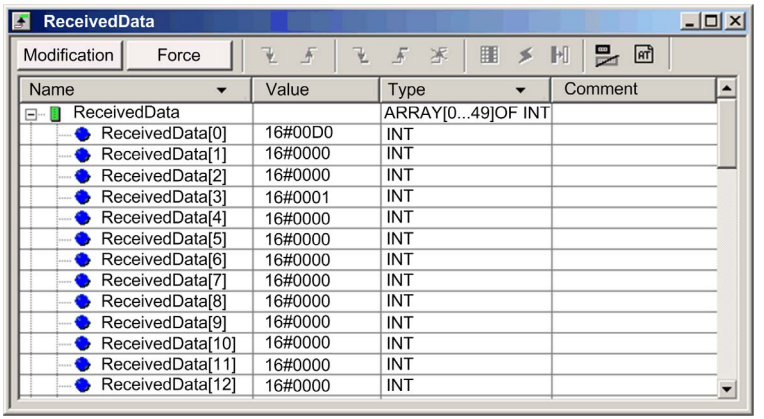
| Variable | Description | Value (hex) |
|---|---|---|
| DataToSend[0] | CIP request service information:<br>● High byte = request size in words: 16#02 (2 decimal)<br>● Low byte = service code: 16#4E (78 decimal) | 16#024E |
| DataToSend[1] | CIP request class information:<br>● High byte = class: 16#44 (68 decimal)<br>● Low byte = class segment: 16#20 (32 decimal) | 16#4420 |
| DataToSend[2] | CIP request instance information:<br>● High byte = instance: 16#01 (1 decimal)<br>● Low byte = instance segment: 16#24 (36 decimal) | 16#0124 |
| DataToSend[3] | Location of first word to be read):<br>● High byte = 16#00 (0 decimal)<br>● Low byte = 16#31 (49 decimal) | 16#0031 |
| DataToSend[4] | Number of words to read:<br>● High byte = attribute: 16#00 (0 decimal)<br>● Low byte = attribute segment: 16#01 (1 decimal) | 16#0001 |

## Viewing the Response

Use a Unity Pro Animation table to display the ReceivedData variable array. Note that the ReceivedData variable array consists of the entire data buffer.

To display the CIP response, follow these steps:

| Step | Action | |
|---|---|---|
| 1 | In Unity Pro, select **Tools** →**Project Browser** to open the Project Browser. | |
| 2 | In the Project Browser, select the **Animation Tables** folder, then click the right mouse button. A pop-up menu appears. | |
| 3 | Select **New Animation Table** in the pop-up menu. A new animation table and its properties dialog both open. | |
| 4 | In the Properties dialog, edit the following values: | |
| | **Name** | Type in a table name. For this example: **ReceivedData**. |
| | **Functional module** | Accept the default **<None>**. |
| | **Comment** | (Optional) Type your comment here. |
| | **Number of animated characters** | Type in **49**, representing the size of the data buffer in words. |

| Step | Action |
|---|---|
| 5 | The completed **Properties** dialog looks like this:<br>  <br><br>Click **OK** to close the dialog. |
| 6 | In the animation table's **Name** column, type in the name of the variable assigned to the RECP pin: **ReceivedData** and hit **Enter**. The animation table displays the ReceivedData variable. |
| 7 | Expand the ReceivedData variable to display its word array, where you can view the CIP response contained in the ReceivedData variable:<br>  <br><br>**Note:** Each array entry presents 2 bytes of data in little endian format, where the least significant byte is stored in the smallest memory address. For example, 'CE' in word[0] is the lower byte, and '00' is the upper byte. |

| Name | Value | Type | Comment |
|---|---|---|---|
| ReceivedData | | ARRAY[0...49]OF INT | |
| ReceivedData[0] | 16#00D0 | INT | |
| ReceivedData[1] | 16#0000 | INT | |
| ReceivedData[2] | 16#0000 | INT | |
| ReceivedData[3] | 16#0001 | INT | |
| ReceivedData[4] | 16#0000 | INT | |
| ReceivedData[5] | 16#0000 | INT | |
| ReceivedData[6] | 16#0000 | INT | |
| ReceivedData[7] | 16#0000 | INT | |
| ReceivedData[8] | 16#0000 | INT | |
| ReceivedData[9] | 16#0000 | INT | |
| ReceivedData[10] | 16#0000 | INT | |
| ReceivedData[11] | 16#0000 | INT | |
| ReceivedData[12] | 16#0000 | INT | |

# EtherNet/IP Explicit Message Example: Write Modbus Object

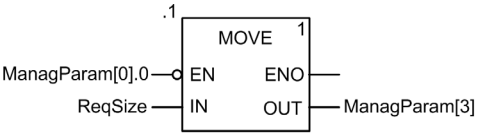
## Overview

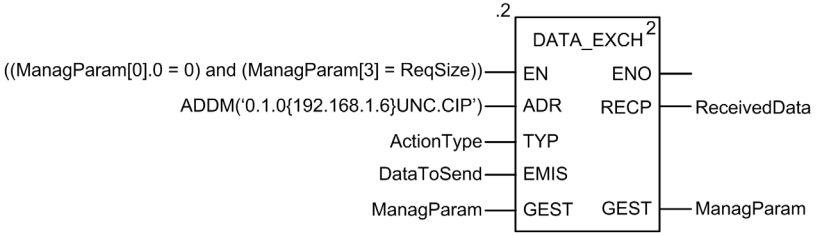
The following unconnected explicit messaging example shows you how to use the DATA_EXCH function block to write data to a remote device—in this case an STB NIC 2212 network interface module at IP address 192.168.1.6—using the Write_Holding_Registers service of the Modbus Object.

You can perform the same explicit messaging service using the **EtherNet/IP Explicit Message** window of the Unity Pro Ethernet Configuration Tool *(see page 300)*.

## Implementing the DATA_EXCH Function Block

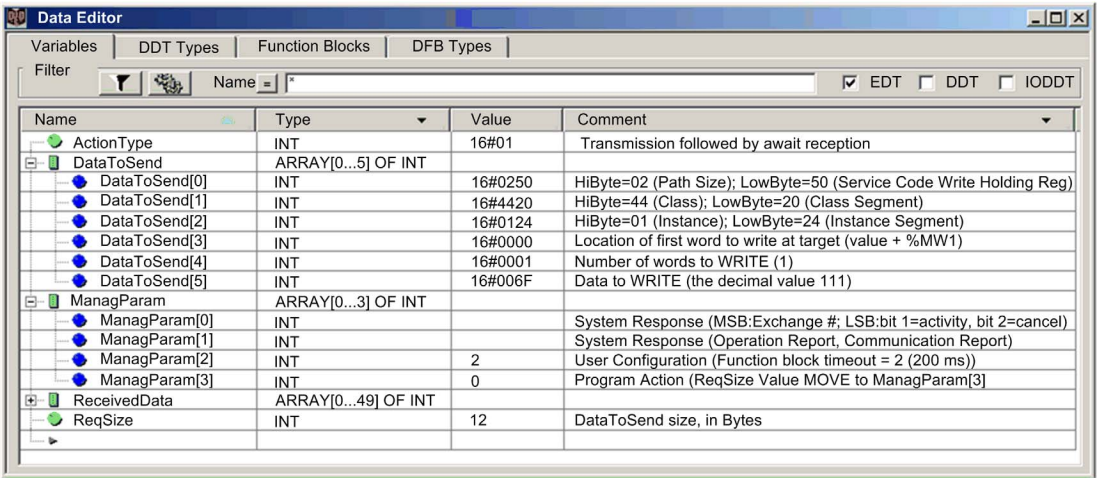
To implement the DATA_EXCH function block, you need to create and assign variables for the following blocks:



## Declaring Variables

In this example, the following variables were defined. You can, of course, use different variable names in your explicit messaging configurations.




| Name | Type | Value | Comment |
|---|---|---|---|
| ActionType | INT | 16#01 | Transmission followed by await reception |
| DataToSend | ARRAY[0...5] OF INT | | |
| DataToSend[0] | INT | 16#0250 | HiByte=02 (Path Size); LowByte=50 (Service Code Write Holding Reg) |
| DataToSend[1] | INT | 16#4420 | HiByte=44 (Class); LowByte=20 (Class Segment) |
| DataToSend[2] | INT | 16#0124 | HiByte=01 (Instance); LowByte=24 (Instance Segment) |
| DataToSend[3] | INT | 16#0000 | Location of first word to write at target (value + %MW1) |
| DataToSend[4] | INT | 16#0001 | Number of words to WRITE (1) |
| DataToSend[5] | INT | 16#006F | Data to WRITE (the decimal value 111) |
| ManagParam | ARRAY[0...3] OF INT | | |
| ManagParam[0] | INT | | System Response (MSB:Exchange #; LSB:bit 1=activity, bit 2=cancel) |
| ManagParam[1] | INT | | System Response (Operation Report, Communication Report) |
| ManagParam[2] | INT | 2 | User Configuration (Function block timeout = 2 (200 ms)) |
| ManagParam[3] | INT | 0 | Program Action (ReqSize Value MOVE to ManagParam[3] |
| ReceivedData | ARRAY[0...49] OF INT | | |
| ReqSize | INT | 12 | DataToSend size, in Bytes |

## Configuring the Address Variable

The Address variable identifies the explicit message originating device (in this example, the communication module) and the target device. Note that the Address variable does not include the Xway address elements {Network.Station} because we are not bridging through another PLC station. Use the `ADDM` function to convert the following character string to an address:

`ADDM`('0.1.0{192.168.1.6}UNC.CIP'), where:

- rack = 0
- module (slot number) = 1
- channel = 0
- remote device IP address = 192.168.1.6
- message type = unconnected
- protocol = CIP

## Configuring the ActionType Variable

The ActionType variable identifies the function type for the `DATA_EXCH` function block:

| Variable | Description | Value (hex) |
|---|---|---|
| ActionType | Transmission followed by wait for response | 16#01 |

## Configuring the DataToSend Variable

The DataToSend variable identifies the type of explicit message and the CIP request:

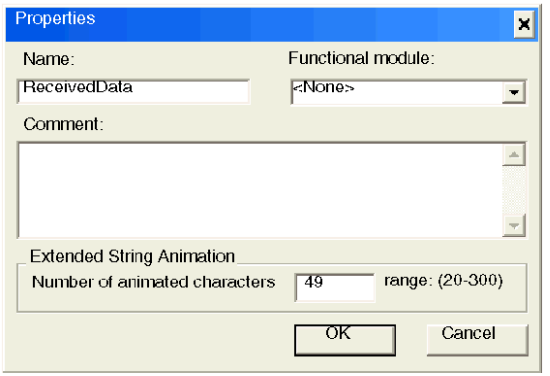
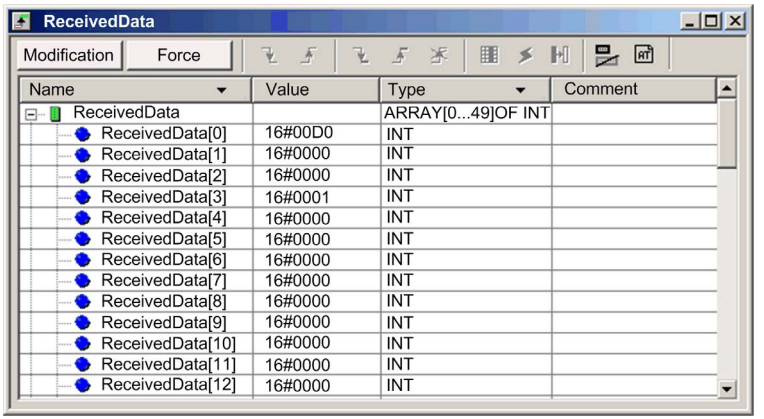
| Variable | Description | Value (hex) |
|---|---|---|
| DataToSend[0] | CIP request service information:<br>● High byte = request size in words: 16#02 (2 decimal)<br>● Low byte = service code: 16#50 (80 decimal) | 16#0250 |
| DataToSend[1] | CIP request class information:<br>● High byte = class: 16#44 (68 decimal)<br>● Low byte = class segment: 16#20 (32 decimal) | 16#4420 |
| DataToSend[2] | CIP request instance information:<br>● High byte = instance: 16#01 (1 decimal)<br>● Low byte = instance segment: 16#24 (36 decimal) | 16#0124 |
| DataToSend[3] | Location of first word to write (+ %MW1):<br>● High byte = 16#00 (0 decimal)<br>● Low byte = 16#00 (0 decimal) | 16#0000 |
| DataToSend[4] | Number of words to write:<br>● High byte = attribute: 16#00 (0 decimal)<br>● Low byte = attribute segment: 16#01 (1 decimal) | 16#0001 |
| DataToSend[5] | Data to write:<br>● High byte = attribute: 16#00 (0 decimal)<br>● Low byte = attribute segment: 16#6F (111 decimal) | 16#006F |

## Viewing the Response

Use a Unity Pro Animation table to display the ReceivedData variable array. Note that the ReceivedData variable array consists of the entire data buffer.

To display the CIP response, follow these steps:

| Step | Action | |
|---|---|---|
| 1 | In Unity Pro, select **Tools** →**Project Browser** to open the Project Browser. | |
| 2 | In the Project Browser, select the **Animation Tables** folder, then click the right mouse button. A pop-up menu appears. | |
| 3 | Select **New Animation Table** in the pop-up menu. A new animation table and its properties dialog both open. | |
| 4 | In the Properties dialog, edit the following values: | |
| | **Name** | Type in a table name. For this example: **ReceivedData**. |
| | **Functional module** | Accept the default **<None>**. |
| | **Comment** | (Optional) Type your comment here. |
| | **Number of animated characters** | Type in **49**, representing the size of the data buffer in words. |

| Step | Action |
|---|---|
| 5 | The completed **Properties** dialog looks like this:<br>  <br><br>Click **OK** to close the dialog. |
| 6 | In the animation table's **Name** column, type in the name of the variable assigned to the RECP pin: **ReceivedData** and hit **Enter**. The animation table displays the ReceivedData variable. |
| 7 | Expand the ReceivedData variable to display its word array, where you can view the CIP response contained in the ReceivedData variable:<br>  <br><br>**Note:** Each array entry presents 2 bytes of data in little endian format, where the least significant byte is stored in the smallest memory address. For example, 'D0' in word[0] is the lower byte, and '00' is the upper byte. |

# Section 8.3
# Modbus TCP Explicit Messaging Using DATA_EXCH

## Overview

This section shows you how to configure `DATA_EXCH` function block parameters for Modbus TCP explicit messages.

## What Is in This Section?

This section contains the following topics:


| Topic | Page |
|---|---|
| Modbus TCP Explicit Messaging Function Codes | 292 |
| Configuring Modbus TCP Explicit Messaging Using DATA_EXCH | 293 |
| EtherNet/IP Explicit Message Example: Read Register Request | 295 |

# Modbus TCP Explicit Messaging Function Codes

## Overview

You can execute Modbus TCP explicit messages using either a Unity Pro `DATA_EXCH` function block or the Unity Pro Ethernet Configuration Tool's **Modbus Explicit Message Window**.

**NOTE:** Configuration edits made to an Ethernet communication module from the Unity Pro Ethernet Configuration Tool are not saved to the operating parameters stored in the CPU and, therefore, are not sent by the CPU to the module on startup.

## Function Codes

The function codes supported by the Unity Pro graphical user interface include the following standard explicit messaging functions:

| Function Code (dec) | Description |
|---|---|
| 1 | Read bits (%M) |
| 2 | Read input bits (%I) |
| 3 | Read words (%MW) |
| 4 | Read input words (%IW) |
| 15 | Write bits (%M) |
| 16 | Write words (%MW) |

**NOTE:** You can use the `DATA_EXCH` function block to execute any Modbus function, via program logic. Because the available function codes are too numerous to list here, refer instead to the Modbus IDA website for more information about these Modbus functions, at:

**NOTE:** http://www.Modbus.org.

# Configuring Modbus TCP Explicit Messaging Using DATA_EXCH

## Introduction

When you use the DATA_EXCH block to create an explicit message for a Modbus TCP device, configure this block the same way you would configure it for any other Modbus communication. Refer to the Unity Pro online help for instructions on how to configure the DATA_EXCH block.

## Configuring ADDM Block Unit ID Settings

When you configure the DATA_EXCH block, use the ADDM block to set the DATA_EXCH block's Address parameter. The ADDM block presents the configuration format ADDM('rack.slot.channel[ip_address}UnitID.message_type.protocol') where:

| The parameter... | Represents... |
|---|---|
| rack | the number assigned to the rack containing the communication module |
| slot | the position of the communication module in the rack |
| channel | the communication channel—set to a value of 0 |
| ip_address | the IP address of the remote device, for example, 192.168.1.7 |
| Unit ID | the destination node address, also known as the Modbus Plus on Ethernet Transporter (MET) mapping index value |
| message_type | the three character string **TCP** |
| protocol | the three character string **MBS** |

The Unit ID value in a Modbus message indicates the destination of the message. The manner in which the communication module handles the Unit ID value depends upon its role as either a server or a client. When the communication module acts as a:

- **server:** a message with Unit ID value of 255 is directed to and processed by the communication module itself. Other messages are passed to the CPU.
- **client:** a message with Unit ID value of 255 is directed to and handled by the communication module itself. Other values are passed to the CPU.

### Contents of the Received_Data Parameter

The `Received_Data` parameter contains the Modbus response. The length of the response varies, and is reported by `Management_Param[3]` after the response is received. The format of the Modbus response is described, below:

| Offset (words) | Length (bytes) | Description |
|---|---|---|
| 0 | 2 | First word of the Modbus response:<br>● High byte (MSB):<br>  ● if successful: Modbus Function Code<br>  ● if not: Modbus function code + 16#80<br>● Low byte (LSB):<br>  ● if successful: depends on the request<br>  ● if not: Modbus exception code<br>  *(see page 403)* |
| 1 | Length of the `Received_Data` parameter – 2 | Remainder of the Modbus response: depends on the specific Modbus request) |

**NOTE:** Structure the response in little endian order.

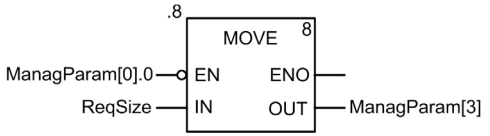
# EtherNet/IP Explicit Message Example: Read Register Request

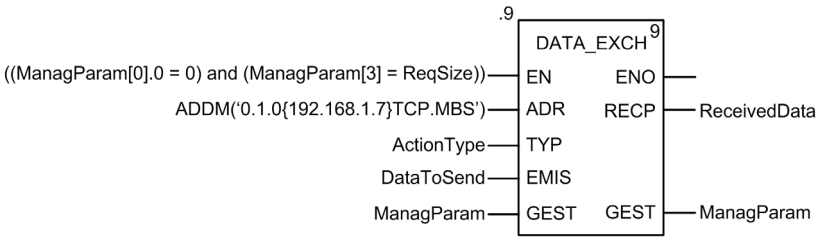
## Overview

The following example shows you how to use the DATA_EXCH function block to send an explicit messaging Modbus TCP request to a remote device—in this case an STB NIP 2212 network interface module at IP address 192.168.1.7—to read a single word located in the remote device at register 5391.

## Implementing the DATA_EXCH Function Block

To implement the DATA_EXCH function block, you need to create and assign variables for the following blocks:

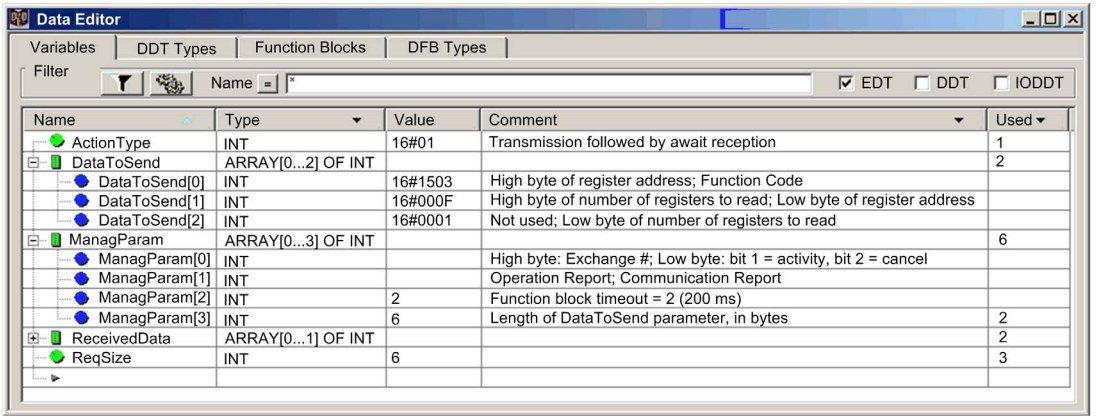


## Declaring Variables

In this example, the following variables were defined. You can, of course, use different variable names in your explicit messaging configurations.

In this example, the following variables were defined. You can, of course, use different variable names in your explicit messaging configurations.




| Name | Type | Value | Comment | Used |
|---|---|---|---|---|
| ActionType | INT | 16#01 | Transmission followed by await reception | 1 |
| DataToSend | ARRAY[0...2] OF INT | | | 2 |
| DataToSend[0] | INT | 16#1503 | High byte of register address; Function Code | |
| DataToSend[1] | INT | 16#000F | High byte of number of registers to read; Low byte of register address | |
| DataToSend[2] | INT | 16#0001 | Not used; Low byte of number of registers to read | |
| ManagParam | ARRAY[0...3] OF INT | | | 6 |
| ManagParam[0] | INT | | High byte: Exchange #; Low byte: bit 1 = activity, bit 2 = cancel | |
| ManagParam[1] | INT | | Operation Report; Communication Report | |
| ManagParam[2] | INT | 2 | Function block timeout = 2 (200 ms) | |
| ManagParam[3] | INT | 6 | Length of DataToSend parameter, in bytes | 2 |
| ReceivedData | ARRAY[0...1] OF INT | | | 2 |
| ReqSize | INT | 6 | | 3 |

## Configuring the Address Variable

The Address variable identifies the explicit message originating device (in this example, the communication module) and the target device. Note that the Address variable does not include the Xway address elements {Network.Station} because we are not bridging through another PLC station. Use the `ADDM` function to convert the following character string to an address:

`ADDM`('0.1.0{192.168.1.7}TCP.MBS'), where:

- rack = 0
- module (slot number) = 1
- channel = 0
- remote device IP address = 192.168.1.7
- message type = TCP
- protocol = Modbus

## Configuring the ActionType Variable

The ActionType variable identifies the function type for the `DATA_EXCH` function block:

| Variable | Description | Value (hex) |
|---|---|---|
| ActionType | Transmission followed by wait for response | 16#01 |

## Configuring the DataToSend Variable

The DataToSend variable contains the target register address and the number of registers to read:

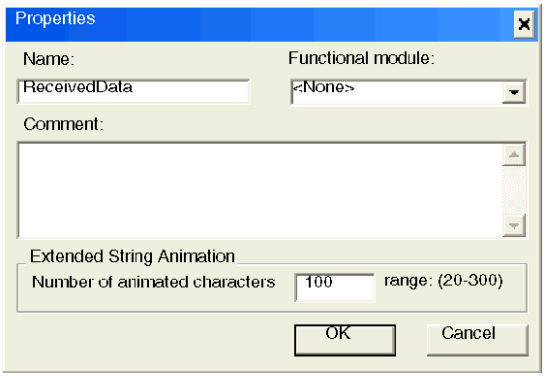
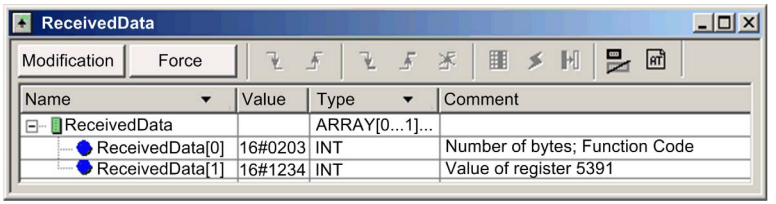
| Variable | Description | Value (hex) |
|---|---|---|
| DataToSend[0] | • High byte = Most significant byte (MSB) of register address 16#15 (21 decimal)<br>• Low byte = function code: 16#03 (03 decimal) | 16#1503 |
| DataToSend[1] | • High byte = Most significant byte (MSB) of the number of registers to read: 16#00 (0 decimal)<br>• Low byte = Least significant byte (LSB) of register address: 16#0F (15 decimal) | 16#000F |
| DataToSend[2] | CIP request instance information:<br>• High byte = not used: 16#00 (0 decimal)<br>• Low byte = Least significant byte (LSB) of the number of registers to read: 16#01 (1 decimal) | 16#0001 |

## Viewing the Response

Use a Unity Pro Animation table to display the ReceivedData variable array. Note that the ReceivedData variable array consists of the entire data buffer.

To display the Modbus TCP response, follow these steps:

| Step | Action | |
|---|---|---|
| 1 | In Unity Pro, select **Tools** →**Project Browser** to open the Project Browser. | |
| 2 | In the Project Browser, select the **Animation Tables** folder, then click the right mouse button. A pop-up menu appears. | |
| 3 | Select **New Animation Table** in the pop-up menu. A new animation table and its properties dialog both open. | |
| 4 | In the Properties dialog, edit the following values: | |
| | **Name** | Type in a table name. For this example: **ReceivedData**. |
| | **Functional module** | Accept the default **<None>**. |
| | **Comment** | (Optional) Type your comment here. |
| | **Number of animated characters** | Type in **100**, representing the size of the data buffer in words. |

| Step | Action |
|---|---|
| 5 | The completed **Properties** dialog looks like this:<br>  <br><br>Click **OK** to close the dialog. |
| 6 | In the animation table's **Name** column, type in the name of the variable assigned to the databuffer: **ReceivedData** and hit **Enter**. The animation table displays the ReceivedData variable. |
| 7 | Expand the ReceivedData variable to display its word array, where you can view the CIP response contained in the ReceivedData variable:<br>  <br><br>**Note:** Each array entry presents 2 bytes of data in little endian format. For example, '03' in word[0] is the low byte, and '02' is the high byte. |

# Section 8.4
## Explicit Messaging via the Unity Pro GUI

### What Is in This Section?

This section contains the following topics:


| Topic | Page |
|---|---|
| Sending Explicit Messages to EtherNet/IP Devices | 300 |
| Sending Explicit Messages to Modbus TCP Devices | 302 |

# Sending Explicit Messages to EtherNet/IP Devices

## Overview

Use the **EtherNet/IP Explicit Message** window to send an explicit message from Unity Pro to an EtherNet/IP module or device on the network.

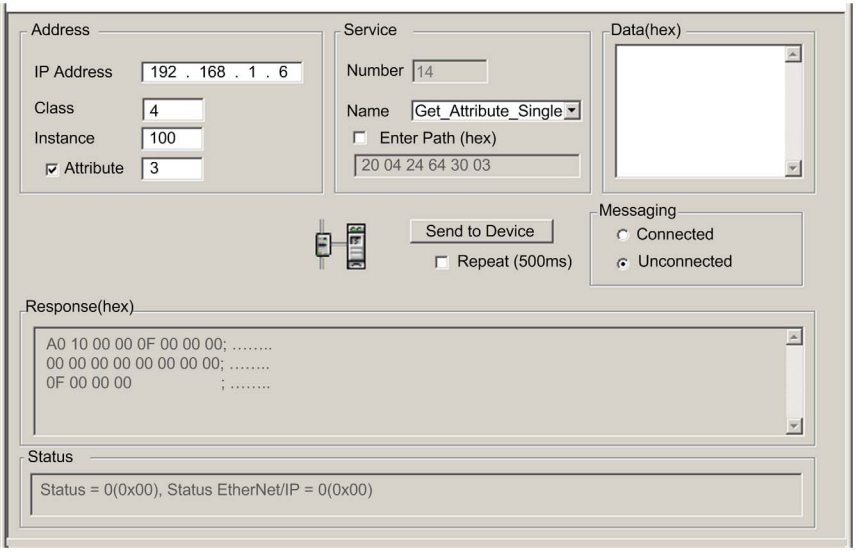
An explicit message can be sent as either a connected, or an unconnected message:

- an unconnected message requires path — or addressing — information identifying the destination device and, optionally, device attributes
- a connected explicit message contains both path information and a connection identifier to the target device

You can use explicit messaging to perform many different services. Not every EtherNet/IP device supports every service.

**NOTE:** Before you can perform explicit messaging, connect the DTM for the upstream communication module to the module itself. To do this, select the module node in the **DTM Browser**, then select **Edit** →**Connect**.

The **EtherNet/IP Explicit Message** window, below, presents an example of both the configuration of an EtherNet/IP explicit message and the response. The explicit message is addressed to a remote STB NIC 2212 network interface module to obtain diagnostic information.




## Sending Explicit Messages

The following steps explain how to execute the EtherNet/IP explicit message, depicted above:

| Step | Action | |
|---|---|---|
| 1 | In the **DTM Browser**, select the communication module that is upstream of the target device. | |
| 2 | Click the right mouse button, and in the pop-up menu select **Device menu** →**EtherNet/IP Explicit Message**.<br>**Result**: The **EtherNet/IP Explicit Message** window opens. | |
| 3 | Configure the explicit message using the following fields: | |
| | IP Address | The IP address of the target device, used to identify the target of the explicit message. In the above example: **192.168.1.6**. |
| | Class | The class identifier of the target device, used in the construction of the message path. An integer from 1 to 65535. In this example: **4**. |
| | Instance | The class instance of the target device, used in the construction of the message path. An integer from 0 to 65535. In this example: **100**. |
| | Attribute | (Optional) The specific device attribute — or property — that is the target of the explicit message, used in the construction of the message path. An integer from 0 to 65535. In this example: **3**<br>**NOTE:** Select the check box to enable this field. |
| | **NOTE:** Refer to your EtherNet/IP device user manual for class, instance and attribute values. | |
| | Number | The integer associated with the service to be performed by the explicit message. An integer from 1 to 127.<br>**NOTE:** If you select **Custom Service** as the named service, type in a service number. This field is read-only for all other services. |
| | Name | Select the service the explicit message is intended to perform. In this example: **Get_Attribute_Single**. |
| | Enter Path | (Optional) Select this check box to enable the message path field, where you can manually enter the entire path to the target device. In this example, the path is not manually entered.<br>**NOTE:** Displayed only when **Advanced Mode** is enabled. |
| | Data | The data to be sent to the target device, for services that send data. In this example, leave blank. |
| | Messaging | Select the type of explicit message to send:<br>● **Connected**<br>● **Unconnected**<br>In this example, select **Unconnected**. |
| | Repeat 500 ms | Select this check box to re-send the explicit message every 500 ms. In this example, leave this blank. |
| 4 | After your explicit message is configured, click **Send to Device**.<br>The **Response** area displays the data sent to the configuration tool by the target device in hexadecimal format.<br>The **Status** area displays messages indicating whether or not the explicit message has succeeded. | |
| 5 | Click **Close** to close the window. | |

# Sending Explicit Messages to Modbus TCP Devices

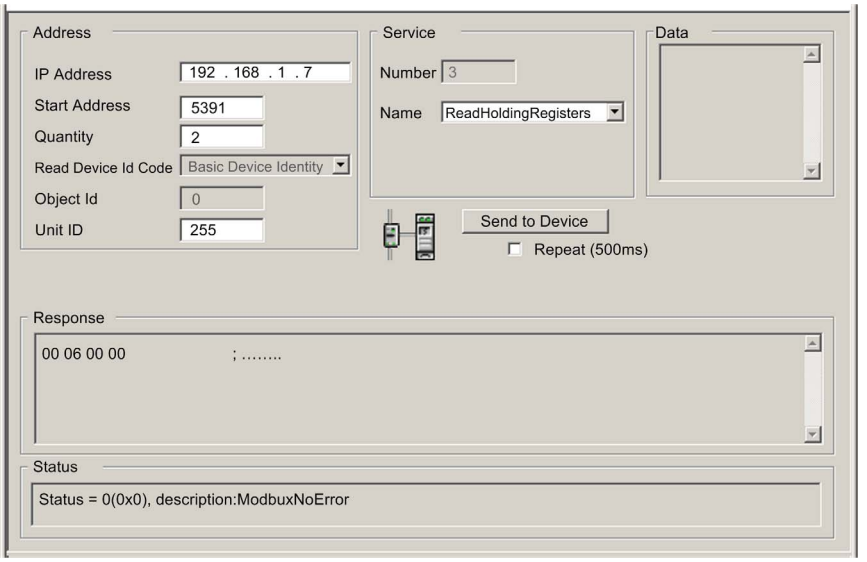
## Overview

Use the **Modbus Explicit Message** window to send an explicit message from Unity Pro to a Modbus TCP module or device on the network.

You can use explicit messaging to perform many different services. Not all Modbus TCP devices support all services.

**NOTE:** Before you can perform explicit messaging, connect the DTM for the upstream communication module to the module itself. To do this, select the module node in the **DTM Browser**, then select **Edit** →**Connect**.

The **Modbus TCP Explicit Message** window, below, presents an example of both the configuration of a Modbus TCP explicit message, and the response. In this example, the explicit message is used to read 2 registers in the remote STB NIP 2212 network interface module, starting at offset 5391.



## Sending Explicit Messages

To send an explicit message to a target Modbus TCP device:

| Step | Action | |
|---|---|---|
| 1 | In the **DTM Browser**, select the communication module that is upstream of the target device. | |
| 2 | Click the right mouse button, and in the pop-up menu select **Device menu** → **Modbus Explicit Message**.<br>**Result**: The **Modbus Explicit Message** window opens. | |
| 3 | Configure the explicit message using the following fields: | |
| | IP Address | The IP address of the target device, used to identify the target of the explicit message. In this example: **192.168.1.7**. |
| | Start Address | A component of the addressing path. In this example **5391**. |
| | Quantity | A component of the addressing path. In this example **2**. |
| | Read Device Id Code | (read-only) The service the explicit message is intended to perform. In this example **Basic Device Identity**. Not used in this example. |
| | Object Id | (read-only) Specify the object the explicit message is intended to access. In this example **0**. Not used in this example. |
| | Refer to your Modbus TCP device user manual for Start Address, Quantity, Read Device Id Code, and Object Id values. | |
| | Unit Id | The number of the device, or module, that is the target of the connection. A value of:<br>● 255 (the default) used to access the Ethernet communication module itself<br>● 0...254 identifies the device number of the target device, behind a Modbus TCP to Modbus gateway |
| | Number | (read-only) The integer associated with the service to be performed by the explicit message. An integer from 0...255. |
| | Name | Select the service the explicit message is intended to perform. In this example **ReadHoldingRegisters** |
| | Repeat 500ms | Select this check box to re-send the explicit message every 500 ms. Leave this check box de-selected. |
| 4 | After your explicit message is configured, click **Send to Device**.<br>The **Response** area displays any data sent to the configuration tool by the target device in hexadecimal format.<br>The **Status** area displays messages indicating whether or not the explicit message has succeeded. | |
| 5 | Click **Close** to close the window. | |

# Chapter 9
# Diagnostics

## Overview

This chapter describes methods of diagnosing the condition of the Ethernet communication module provided by the:

- Ethernet communication module hardware, and
- Unity Pro configuration software

## What Is in This Chapter?

This chapter contains the following sections:


| Section | Topic | Page |
|---|---|---|
| 9.1 | Module Hardware Diagnostics | 306 |
| 9.2 | Unity Pro Software Diagnostics | 308 |
| 9.3 | CPU I/O Block Diagnostics | 332 |

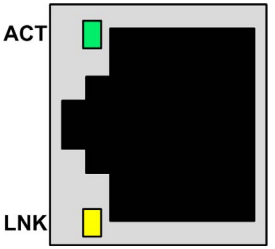
# Section 9.1
## Module Hardware Diagnostics

## LED Indicators for the BMX NOC 0401

### LED Indicators

The BMX NOC 0401 module displays the following indicators in the LED display area:

The module also displays the following LED indicators next to each Ethernet port connector:




### LED Descriptions

Use the LED display to diagnose the state of the module, as follows:

| LED | Color | Description |
|---|---|---|
| RUN | Green | • **Off:** Indicates that the module is not communicating with the CPU over the backplane.<br>• **Steady Green:** Indicates that the module:<br>  • has just been turned on and has not yet started the LED power-up test, or<br>  • is communicating with the CPU over the backplane |
| ERR | Red | • **Off:** The module is operating normally.<br>• **Blinking Red:** The module is not configured (or the configuration is in progress), or backplane communication has stopped.<br>• **Steady Red:** The module has detected an event. |

| LED | Color | Description |
|---|---|---|
| MS<br>(Module Status) | Green/<br>Red | ● **Off:** Power is not being supplied to the module.<br>● **Steady Green:** The module is operating normally.<br>● **Blinking Green:** The module has not been configured.<br>● **Steady Red:** The module has detected a major event.<br>● **Blinking Red:** The module has detected a recoverable event. |
| NS<br>(Network Status) | Green/<br>Red | ● **Off:** Power is not being supplied to the module, or the module has not been assigned an IP address.<br>● **Steady Green:** The module has established at least one CIP connection.<br>● **Blinking Green:** The module has obtained an IP address but has not established any CIP connections.<br>● **Steady Red:** The module has detected that its IP address is a duplicate IP address.<br>● **Blinking Red:** One or more CIP connection (with the module as target) have timed out. |
| ETH STS<br>(Ethernet Status) | Amber | ● **Off:** No power is supplied to the module.<br>● **Steady Amber:** Indicates that the module is operating normally.<br>● **Four flashes:** The module has detected a duplicate IP address.<br>● **Five flashes:** The module is waiting for a served IP address.<br>● **Six flashes:** The module is using its default IP address.<br>● **Seven flashes:** The module has detected a configuration error.<br>**NOTE:** If more than one diagnostic condition exists simultaneously, the Ready LED displays the shortest flash sequence. |
| LNK (Link) | Yellow/<br>Green | ● **Off:** An Ethernet link has not been established.<br>● **Yellow:** A 10 Mbit Ethernet link has been established<br>● **Green:** A 100 Mbit Ethernet link has been established |
| ACT (Activity) | Green | ● **Off:** There is no receive or transmit activity.<br>● **Flashes Green:** Indicates activity. |

# Section 9.2
## Unity Pro Software Diagnostics

### Overview

This section describes the diagnostic tools, provided by the Unity Pro configuration software, that you can use to monitor the condition of the Ethernet communication module.

### What Is in This Section?

This section contains the following topics:


| Topic | Page |
|---|---|
| Using the Diagnostic Window | 309 |
| Ethernet Port Diagnostics | 311 |
| Bandwidth Diagnostics | 314 |
| Email Diagnostics | 317 |
| Network Time Service Diagnostics | 319 |
| Communication Module RSTP Diagnostics | 322 |
| Local Slave / Connection Diagnostics | 325 |
| Local Slave or Connection I/O Value Diagnostics | 329 |
| Logging | 331 |

# Using the Diagnostic Window

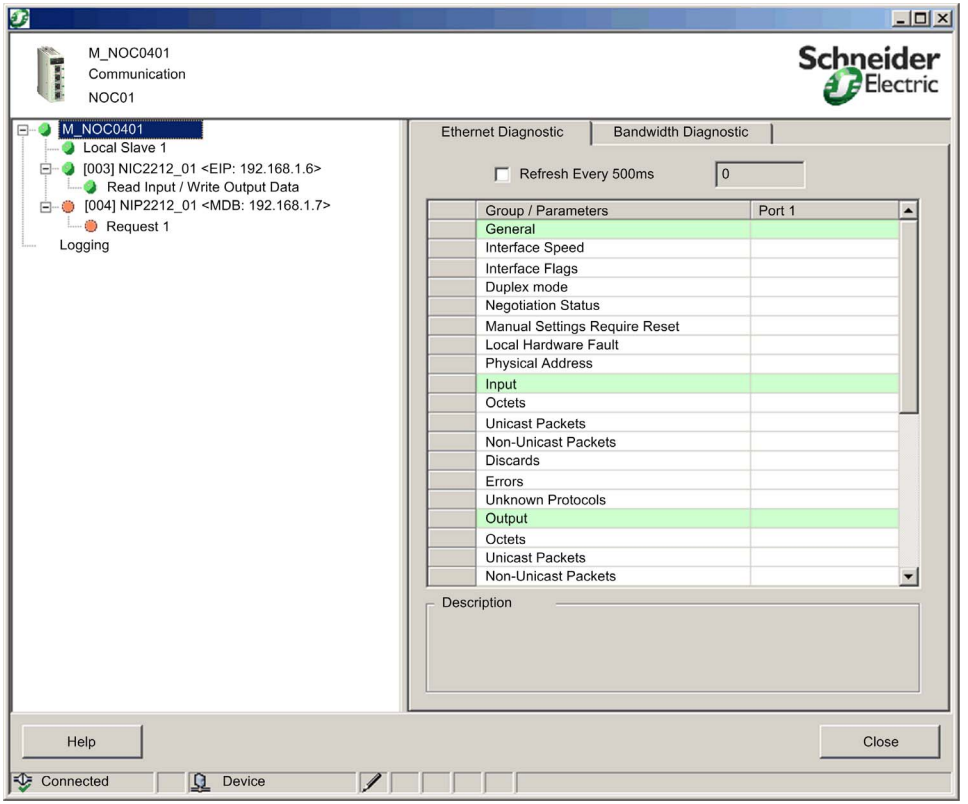
## Introduction

Use the **Diagnostic** window to display:

- LED icons (in the left pane of the window) that indicate the operating status of modules, devices and connections
- pages (in the right pane of the window) that present diagnostic data for the following:
  - the communication module
  - local slave nodes activated for the communication module
  - EtherNet/IP connections between the communication module and a remote EtherNet/IP device

**NOTE:** Before you can open the **Diagnostic** window, connect the DTM for the target communication module to the physical module itself. To do this, select the module node in the **DTM Browser**, then select **Edit** →**Connect**.

The **Diagnostic** window looks like this:



To open the **Diagnostic** window:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select the communication module and click the right mouse button. A pop-up menu opens. |
| 2 | In the menu, select **Device menu** →**Diagnostic**. |

## Diagnostic LED Icons

During the time that a communication module DTM is connected to the physical communication module, Unity Pro sends an explicit message request once per second to detect the state of the communication module and the states of the remote devices and EtherNet/IP connections linked to that module.

Unity Pro places one of the following status icons over the module, device or connection nodes in the left pane of the **Diagnostic** window to indicate its current status:

| This icon... | Indicates the following state for a... | |
|---|---|---|
| | **Communication module** | **Connection to a remote device** |
| | Run state | The health bit for every EtherNet/IP connection and Modbus TCP request, to a remote device or to a sub-device or module, is set to active (1). |
| | One of the following:<br>● unknown<br>● started<br>● stopped<br>● not connected | The health bit for at least one EtherNet/IP connection or Modbus TCP request, to a remote device or to a sub-device or module, is set to inactive (0). |

# Ethernet Port Diagnostics

## Introduction

Use the **Ethernet Diagnostic** page to display either dynamically generated or static data for the communication module's Ethernet port(s). The page displays five columns of data, as follows:

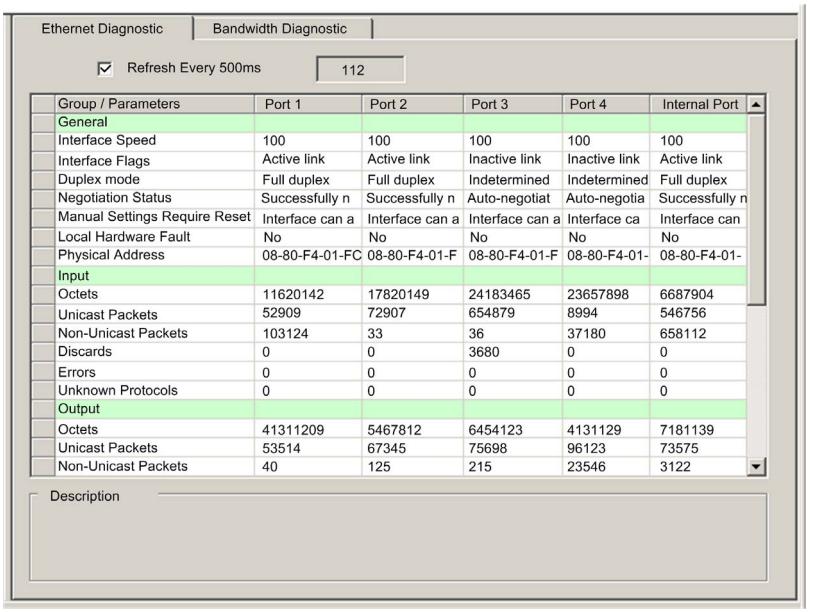
- one column for an module's Internal Port, and
- up to four columns for the enabled external Ethernet ports (ports 1, 2, 3 and 4

Use the **Refresh Every 500ms** checkbox to display static or dynamic data, as follows:

| When the checkbox is... | This page... |
|---|---|
| Selected | • Displays data that is dynamically updated every 500 ms, and<br>• Increments the number at the top of the table each time data is refreshed |
| De-selected | • Displays static data, and<br>• Does not Increment the number at the top of the table, which instead displays a constant value |

**NOTE:** Before you can open the **Diagnostic** window, connect the DTM for the target communication module to the physical module itself. To do this, select the module node in the **DTM Browser**, then select **Edit** →**Connect**.

The **Ethernet Diagnostic** page looks like this:




| Group / Parameters | Port 1 | Port 2 | Port 3 | Port 4 | Internal Port |
|---|---|---|---|---|---|
| General | | | | | |
| Interface Speed | 100 | 100 | 100 | 100 | 100 |
| Interface Flags | Active link | Active link | Inactive link | Inactive link | Active link |
| Duplex mode | Full duplex | Full duplex | Indetermined | Indetermined | Full duplex |
| Negotiation Status | Successfully n | Successfully n | Auto-negotiat | Auto-negotia | Successfully n |
| Manual Settings Require Reset | Interface can a | Interface can a | Interface can a | Interface ca | Interface can |
| Local Hardware Fault | No | No | No | No | No |
| Physical Address | 08-80-F4-01-FC | 08-80-F4-01-F | 08-80-F4-01-F | 08-80-F4-01- | 08-80-F4-01- |
| Input | | | | | |
| Octets | 11620142 | 17820149 | 24183465 | 23657898 | 6687904 |
| Unicast Packets | 52909 | 72907 | 654879 | 8994 | 546756 |
| Non-Unicast Packets | 103124 | 33 | 36 | 37180 | 658112 |
| Discards | 0 | 0 | 3680 | 0 | 0 |
| Errors | 0 | 0 | 0 | 0 | 0 |
| Unknown Protocols | 0 | 0 | 0 | 0 | 0 |
| Output | | | | | |
| Octets | 41311209 | 5467812 | 6454123 | 4131129 | 7181139 |
| Unicast Packets | 53514 | 67345 | 75698 | 96123 | 73575 |
| Non-Unicast Packets | 40 | 125 | 215 | 23546 | 3122 |

To open this page:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select the communication module and click the right mouse button. A pop-up menu opens. |
| 2 | In the menu, select **Device menu** →**Diagnostic**. |
| 3 | In the left pane of the **Diagnostic** window, select the communication module node. |
| 4 | Click on the **Ethernet Diagnostic** tab to open that page. |

## Ethernet Diagnostic Parameters

The **Ethernet Diagnostic** page displays the following parameters for each communication module port:

| Parameter | Description |
|---|---|
| General parameters: | |
| Interface Speed | Valid values include: 0, 10, 100 Mbits/second |
| Interface Flags | Bit 0—Link Status: 0 = Inactive; 1 = Active |
| | Bit 1—Duplex Mode (see below) |
| | Bits 2...4—Negotiation Status (see below) |
| | Bit 5—Manual Setting Requires Reset (see below) |
| | Bit 6—Local Hardware Fault detected (see below) |
| Duplex Mode | 0 = half duplex; 1 = full duplex |
| Negotiation Status | 3 = successfully negotiated speed and duplex<br>4 = forced speed and link |
| Manual Setting Requires Reset | 0 = automatic; 1 = device requires reset |
| Local Hardware Fault | 0 = no event; 1 = event detected |
| Physical Address | Module MAC Address |
| Input parameters: | |
| Octets | Octets received on the interface |
| Unicast Packets | Unicast packets received on the interface |
| Non-Unicast Packets | Non-unicast packets received on the interface |
| Discards | Inbound packets received on the interface, but discarded |
| Errors | Inbound packets that contain detected errors (does not include In Discards) |
| Unknown Protocols | Inbound packets with unknown protocol |
| Output parameters: | |

| Parameter | Description |
|---|---|
| Octets | Octets received on the interface |
| Unicast Packets | Unicast packets received on the interface |
| Non-Unicast Packets | Non-unicast packets received on the interface |
| Discards | Inbound packets received on the interface, but discarded |
| Errors | Outbound packets that contain detected errors (does not include In Discards) |
| Unknown Protocols | Outbound packets with unknown protocol |
| Error counter parameters: | |
| Alignment Errors | Frames that are not an integral number of octets in length |
| FCS Errors | Frames received with a detected FCS checksum error |
| Single Collisions | Successfully transmitted frames that experienced exactly one collision |
| Multiple Collisions | Successfully transmitted frames that experienced more than one collision |
| SQE Test Errors | Number of times the SQE test error is detected |
| Deferred Transmissions | Frames for which first transmission attempt is delayed because the medium is busy |
| Late Collisions | Number of times a collision is detected later than 512 bittimes into the transmission of a packet |
| Excessive Collisions | Frames for which transmission is not successful due to excessive collisions |
| MAC Transmit Errors | Frames for which transmission is not successful due to internal MAC sublayer transmit error |
| Carrier Sense Errors | Times that the carrier sense condition was lost or not asserted when attempting to transmit a frame |
| Frame Too Long | Frames received that exceed the maximum permitted frame size |
| MAC Receive Errors | Frames for which reception on an interface is not successful due to an internal MAC sublayer receive detected error |

# Bandwidth Diagnostics

## Introduction

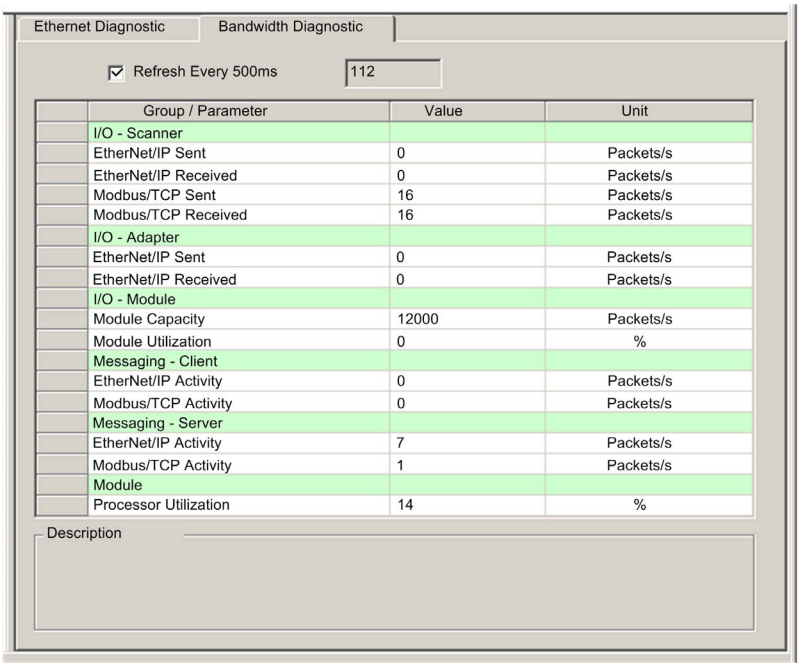
Use the **Bandwidth Diagnostic** page to display either dynamically generated or static data for the communication module's bandwidth usage.

Use the **Refresh Every 500ms** checkbox to display static or dynamic data, as follows:

| When the checkbox is... | This page... |
|---|---|
| Selected | • Displays data that is dynamically updated every 500 ms, and<br>• Increments the number at the top of the table each time data is refreshed |
| De-selected | • Displays static data, and<br>• Does not Increment the number at the top of the table, which instead displays a constant value |

**NOTE:** Before you can open the **Diagnostic** window, connect the DTM for the target communication module to the physical module itself. To do this, select the module node in the **DTM Browser**, then select **Edit** →**Connect**.

The **Bandwidth Diagnostic** page looks like this:



To open this page:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select the communication module and click the right mouse button. A pop-up menu opens. |
| 2 | In the menu, select **Device menu** →**Diagnostic**. The **Diagnostic** window opens. |
| 3 | In the left pane of the **Diagnostic** window, select the communication module node. |
| 4 | Click on the **Bandwidth Diagnostic** tab to open that page. |

## Bandwidth Diagnostic Parameters

The **Bandwidth Diagnostic** page displays the following parameters for the communication module:

| Parameter | Description |
|---|---|
| I/O - Scanner: | |
| EtherNet/IP Sent | The number of EtherNet/IP packets the module has sent, since the last reset, in packets/second. |
| EtherNet/IP Received | The number of EtherNet/IP packets the module has received, since the last reset, in packets/second. |
| Modbus TCP Requests | The number of Modbus TCP requests the module has sent, since the last reset, in packets/second. |
| Modbus TCP Responses | The number of Modbus TCP responses the module has received, since the last reset, in packets/second. |
| I/O - Adapter: | |
| EtherNet/IP Sent | The number of EtherNet/IP packets the module has sent—in the role of a local slave—since the last reset, in packets/second. |
| EtherNet/IP Received | The number of EtherNet/IP packets the module has received—in the role of a local slave—since the last reset, in packets/second. |
| I/O - Module | |
| Module Capacity | The maximum number of packets that the module can process, in packets per second. |
| Module Utilization | The percentage of communication module capacity being used by the application. |
| Messaging - Client: | |
| EtherNet/IP Activity | The number of I/O messages sent by the module—using the EtherNet/IP protocol—since last reset, in packets per second. |

| Parameter | Description |
|---|---|
| Modbus TCP Activity | The number of I/O messages sent by the module—using the Modbus TCP protocol—since last reset, in packets per second. |
| Messaging - Server: | |
| EtherNet/IP Activity | The number of I/O messages received by the module—using the EtherNet/IP protocol—since last reset, in packets per second. |
| Modbus TCP Activity | The number of I/O messages received by the module—using the Modbus TCP protocol—since last reset, in packets per second. |
| Module: | |
| Processor Utilization | The percent of Ethernet communication module processor capacity used by the present level of communication activity. |

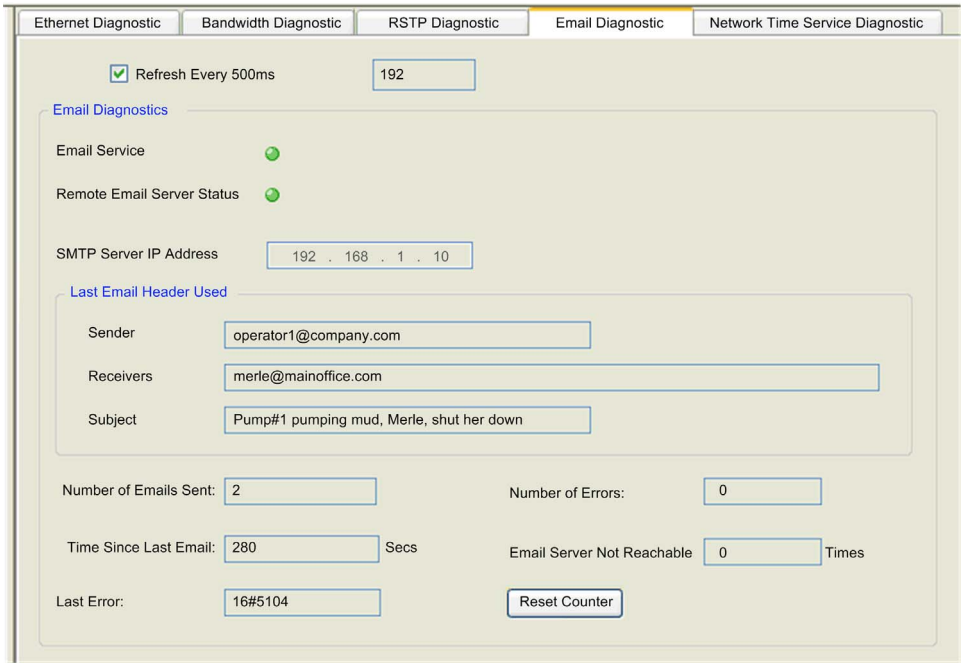
# Email Diagnostics

## Diagnosing SMTP Transmissions

Use the **Email Diagnostic** page to display dynamically generated data describing the communication module's Email message transmissions.

**NOTE:** Before you can open the **Diagnostic** window, connect the DTM for the target communication module to the physical module itself. To do this, select the module node in the **DTM Browser**, then select **Edit** →**Connect**.

The **Email Diagnostic** page looks like this:




Click the **Reset Counter** button to reset the counting statistics on this page to 0.

To open this page:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select the communication module and click the right mouse button. A pop-up menu opens. |
| 2 | In the menu, select **Device menu** →**Diagnostic**. The **Diagnostic** window opens. |
| 3 | In the left pane of the **Diagnostic** window, select the communication module node. |
| 4 | Click on the **Email Diagnostic** tab to open that page. |

## Email diagnostic Parameters

Email service parameters include the following:

| Parameter | Description |
|---|---|
| Refresh Every 500ms | Select this to dynamically update this page every 500ms. The number of times this page has been refreshed appears immediately to the right (in this example, 192. |
| Email Service | The status of this service in the Ethernet communication module:<br>● green = operational (OK)<br>● orange = not operational (NOK) |
| Remote Email Server Status | The connection status between Ethernet communication module and the SMTP server:<br>● green = operational (OK)<br>● red = not operational (NOK)<br>**NOTE:** Status is checked at start-up and at least every 30 minutes after start-up. |
| SMTP Server IP Address | IP address of the SMTP server |
| Sender | The three header fields of the last Email message sent. |
| Receivers | |
| Subject | |
| Number of Emails Sent | Total number of emails sent and successfully acknowledged by the SMTP server. |
| Time Since Last Email | Counts the number of seconds since the last email was successfully sent. |
| Last Error | Hexadecimal code describing the reason for the last unsuccessful Email transmission *(see page 405)*. The value “0” indicates no unsuccessful transmissions. |
| Time Since Last Email | Counts the number of seconds since the last email was successfully sent. |
| Number of Errors | Total number of emails that either:<br>● could not be sent<br>● were sent but were not successfully acknowledged by the SMTP server |
| Email Service Not Reachable | Number of times the SMTP server could not be reached. (Link checked every 30 minutes.) |

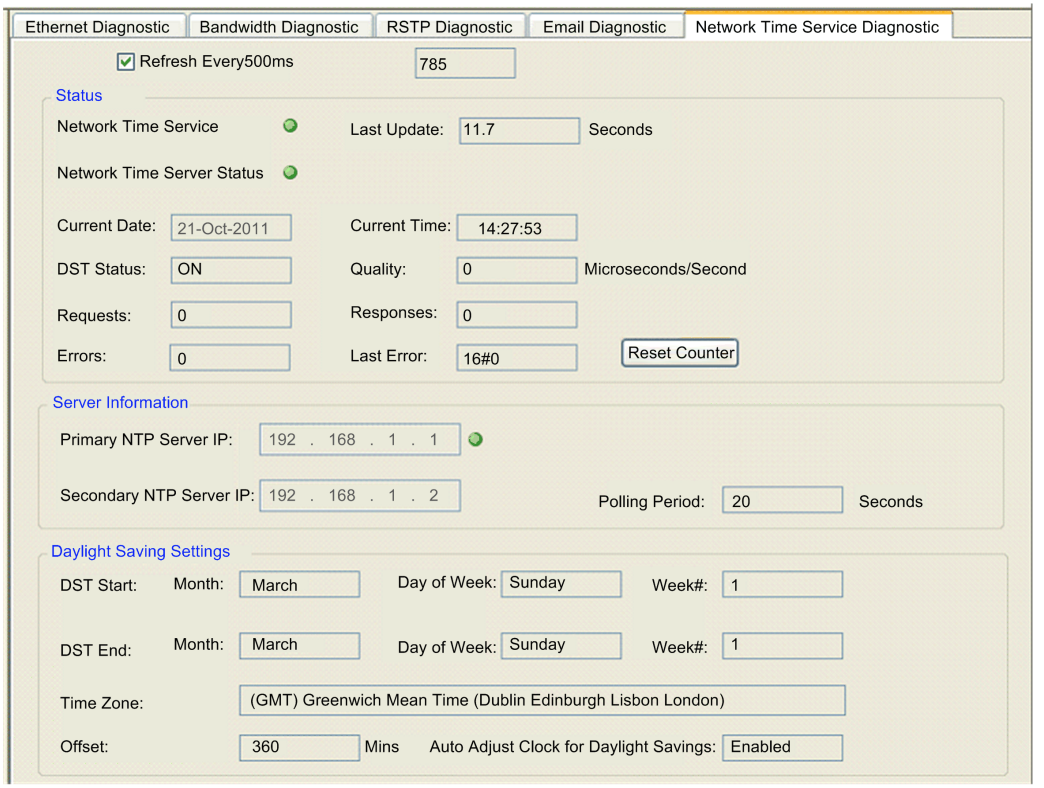
# Network Time Service Diagnostics

## Diagnosing the Network Time Service

Use the **Network Time Service Diagnostic** page to display dynamically generated data describing the operation of the network time protocol (NTP) service that you configured in the Network Time Service page *(see page 97)* in Unity Pro.

**NOTE:** Before you can open the **Diagnostic** window, connect the DTM for the target communication module to the physical module itself. To do this, select the module node in the **DTM Browser**, then select **Edit** →**Connect**.

The **Network Time Service Diagnostic** page looks like this:




Click the **Reset Counter** button to reset the counting statistics on this page to 0.

To open this page:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select the communication module and click the right mouse button. A pop-up menu opens. |
| 2 | In the menu, select **Device menu** →**Diagnostic**. The **Diagnostic** window opens. |
| 3 | In the left pane of the **Diagnostic** window, select the communication module node. |
| 4 | Click on the **NTP Diagnostic** tab to open that page. |

## Network Time Service Diagnostic Parameters

Time synchronization service parameters are in the table:

| Parameter | Description |
|---|---|
| Refresh Every 500ms | Select this to dynamically update this page every 500ms. The number of times this page has been refreshed appears immediately to the right (in this example, 785). |
| Network Time Service | Operational status of the service in the module:<br>● green = operational<br>● orange = not operational |
| Network Time Server Status | Communication status of the NTP server:<br>● green = the NTP server is reachable<br>● red = the NTP server is not reachable |
| Last Update | Elapsed time, in seconds, since the most recent NTP server update. |
| Current Date | System date |
| Current Time | System time in hh:mm:ss format |
| DST Status | The actual working status of the automatic daylight savings service:<br>● ON = automatic adjustment of daylight savings is enabled and the current date and time reflect the daylight savings time adjustment<br>● OFF = automatic adjustment of daylight savings is disabled; or automatic adjustment of daylight savings is enabled, but the current date and time may not reflect the daylight savings time adjustment |
| Quality | The correction, in seconds, applied to the local counter at every NTP server update.Numbers greater than 0 indicate increasingly excessive traffic condition or NTP server overload. |
| Requests | Total number of client requests sent to the NTP server |
| Responses | Total number of server responses sent from the NTP server |
| Errors | Total number of unanswered NTP requests |

| Parameter | Description | |
|---|---|---|
| Last Error | Last detected error code received from the NTP client:<br>● 0: good NTP configuration<br>● 1: late NTP server response (can be caused by excessive network traffic or server overload)<br>● 2: NTP not configured<br>● 3: invalid NTP parameter setting<br>● 4: NTP component disabled<br>● 7: unrecoverable NTP transmission<br>● 9: invalid NTP server IP address<br>● 15: invalid syntax in the custom time zone rules file | |
| Primary / Secondary NTP Server IP | The IP address of the primary and the secondary NTP server<br>**NOTE:** A green LED to the right of the primary or secondary NTP server IP address identifies the currently active server. | |
| Auto Adjust Clock for Daylight Savings | The configuration setting of the daylight savings adjustment service:<br>● enabled<br>● disabled | |
| DST Start / DST End | Specifies the day that daylight savings time begins and ends: | |
| | Month | The month daylight savings time starts or ends |
| | Day of Week | The day of the week daylight savings time starts or ends |
| | Week# | The occurrence of the specified day within the specified month. |
| Time Zone | Time zone plus or minus Universal Time, Coordinated (UTC) | |
| Offset | The time, in minutes, to be combined with the selected Time Zone selection to produce the system time. | |
| Polling Period | The frequency the NTP client requests time updates from the NTP server | |

# Communication Module RSTP Diagnostics

## Introduction

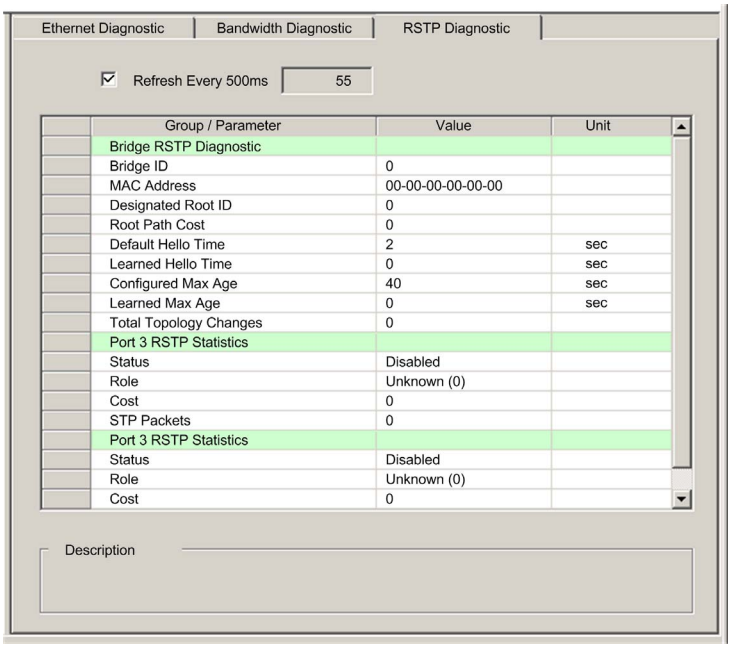
Use the **RSTP Diagnostic** page to display either dynamically generated or static data for a BMX NOC 0401 (M340) communication module's RSTP service.

Use the **Refresh Every 500ms** checkbox to display static or dynamic data, as follows:

| When the checkbox is... | This page... |
|---|---|
| Selected | • Displays data that is dynamically updated every 500 ms, and<br>• Increments the number at the top of the table each time data is refreshed |
| De-selected | • Displays static data, and<br>• Does not Increment the number at the top of the table, which instead displays a constant value |

**NOTE:** Before you can open the **Diagnostic** window, connect the DTM for the target communication module to the physical module. To do this, select the module node in the **DTM Browser**, then select **Edit** →**Connect**.

The **RSTP Diagnostic** page looks like this:



To open this page:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select the communication module and click the right mouse button. A pop-up menu opens. |
| 2 | In the menu, select **Device menu** →**Diagnostic**. |
| 3 | In the left pane of the **Diagnostic** window, select the communication module node. |
| 4 | Click on the **RSTP Diagnostic** tab to open that page. |

## RSTP Diagnostic Parameters

The **RSTP Diagnostic** page displays the following parameters for each communication module port:

| Parameter | Description |
|---|---|
| Bridge RSTP Diagnostic: | |
| Bridge ID | An 8-byte bridge identification field is comprised of a 2 sub-fields:<br>● Bridge Priority: a 2-byte value from 0 to 65535—with a default of 32768—assigned to the module's embedded Ethernet switch<br>● MAC Address (see below) |
| MAC Address | The Media Access Control address of a device, found on the front of the module. |
| Designated Root ID | The Bridge ID of the root switch. |
| Root Path Cost | The aggregate cost of port costs from this switch back to the root switch. |
| Default Hello Time | The interval at which Configuration BPDU messages will be transmitted during a network convergence. For RSTP this is a fixed value of 2 seconds. |
| Learned Hello Time | The current Hello Time value learned from the root switch. |
| Configured Max Age | The value that other switches use for MaxAge when this switch is acting as the root. Valid range: 6 to 40 |
| Learned Max Age | The maximum age learned from the root switch. This is the actual value currently used by this switch. |
| Total Topology Changes | The total number of topology changes detected by this switch since the management entity was last reset or initialized. |
| Ports 3 and 4 RSTP Statistics: | |
| Status | The port's current state as defined by RSTP Protocol. This state controls the action the port takes when it receives a frame. Possible values are: disabled, discarding, learning, forwarding. |
| Role: | The port's current role per RSTP protocol. Possible values are: root port, designated port, alternate port, backup port, disabled port. |

| Parameter | Description |
|---|---|
| Cost | The logical cost of this port as a path to the root switch. If this port is configured for AUTO then the cost is determined based on the connection speed of the port. |
| STP Packets | A value in this field indicates that a device on the network has the STP protocol enabled.<br>**NOTE:**<br>● Other devices, with STP enabled, can severely affect the network convergence times. Schneider Electric recommends the STP protocol (but not the RSTP protocol) be disabled on every network device capable of supporting it.<br>● The communication module does not support the STP protocol. The module's embedded switch ignores ignore STP packets. |

# Local Slave / Connection Diagnostics

## Introduction

The **Local Slave Diagnostic** page and the **EIP Connection Diagnostic** page present common information. Use the:

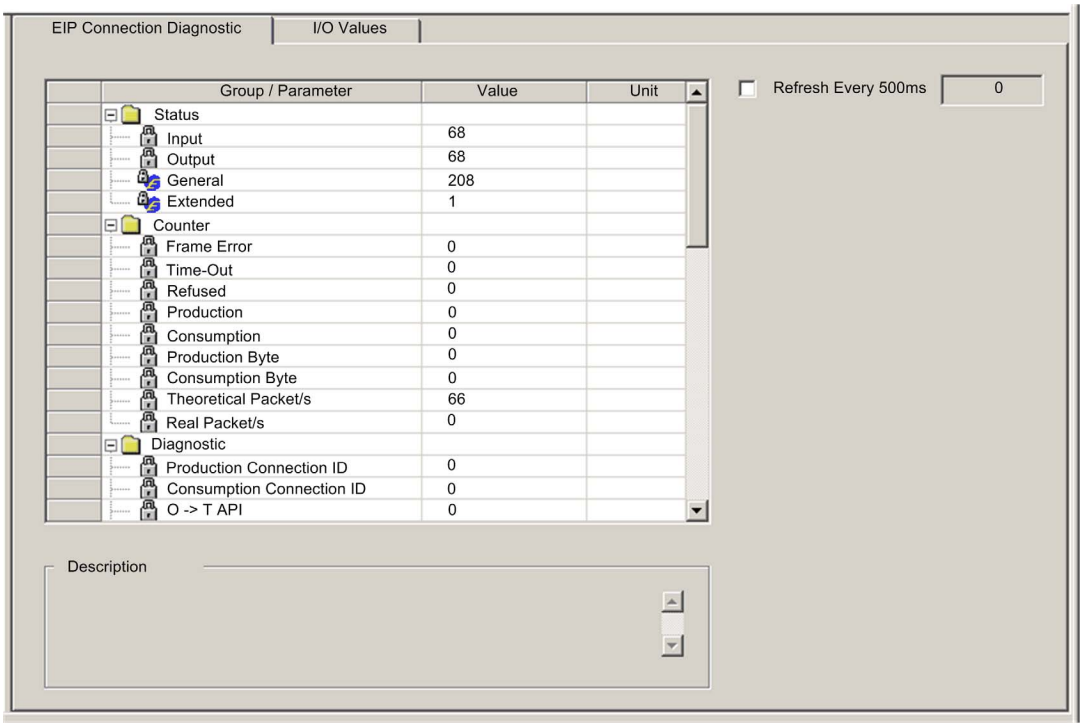
- **Local Slave Diagnostic** page to display I/O status and production/consumption information for a selected local slave
- **EIP Connection Diagnostic** page to display I/O status and production/consumption information for a connection of a remote EtherNet/IP device

Use the **Refresh Every 500ms** checkbox to display static or dynamic data, as follows:

| When the checkbox is... | This page... |
|---|---|
| Selected | • Displays data that is dynamically updated every 500 ms, and<br>• Increments the number at the top of the table each time data is refreshed |
| De-selected | • Displays static data, and<br>• Does not Increment the number at the top of the table, which instead displays a constant value |

**NOTE:** Before you can open the **Diagnostic** window, connect the communication module or remote device DTM to the physical module or device. To do this, select the appropriate node in the **DTM Browser**, then select **Edit** →**Connect**.

The following figure presents an example of the **EIP Connection Diagnostic** page. (Except for the title, the **Local Slave Diagnostic** page is the same.)




To open this page:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select the communication module and click the right mouse button. A pop-up menu opens. |
| 2 | In the menu, select **Device menu** →**Diagnostic**. |
| 3 | In the left pane of the **Diagnostic** window, click on one of the following:<br>● for local slave diagnostics, select the communication module node<br>● for remote device connection diagnostics, select a remote device connection |
| 4 | Depending upon you selection in step 3, above, click on either the **Local Slave Diagnostic** tab or the **EIP Connection Diagnostic** tab to open that page. |

## Diagnostic Parameters

This page displays the following diagnostic parameters for the selected local slave or connection:

| Parameter | Description |
|---|---|
| Status *(see page 328)*: | |
| Input | An integer representing input status. |
| Output | An integer representing output status. |
| General | An integer representing basic connection status. |
| Extended | An integer representing extended connection status. |
| Counter: | |
| Frame Error | Increments each time a frame is not sent by missing resources or is impossible to send. |
| Time-Out | Increments each time a connection times out. |
| Refused | Increments when connection is refused by the remote station. |
| Production | Increments each time a message is produced. |
| Consumption | Increments each time a message is consumed. |
| Production Byte | Total of produced messages, in bytes, since the communication module was last reset. |
| Consumption Byte | Total of consumed messages, in bytes, since the communication module wa last reset. |
| Theoretical Packets per second | Packets per second calculated sing current configuration value. |
| Real Packets per second | Actual number of packets per second generated by this connection. |
| Diagnostic: | |
| Production Connection ID | The connection ID. |
| Consumption Connection ID | The connection ID. |
| O -> T API | Accepted packet interval (API) of the output connection. |
| T -> O API | Accepted packet interval (API) of the input connection. |
| O -> T RPI | Requested packet interval (RPI) of the output connection. |
| T -> O RPI | Requested packet interval (RPI) of the input connection. |
| Socket Diagnostics: | |
| Socket ID | Internal Identification of the socket. |
| Remote IP Address | IP address of the remote station, for this connection. |
| Remote Port | Port number of the remote station, for this connection. |
| Local IP Address | IP address of the communication module, for this connection. |
| Local Port | Port number of the communication module, for this connection. |

## Connection Status Codes

The Input and Output Status diagnostic parameters *(see page 327)*, in the preceding table, can present the following values:

| Input/Output Status (dec) | Description |
|---|---|
| 0 | OK |
| 33 | Time-out |
| 53 | IDLE |
| 54 | Connection established |
| 58 | Not connected (TCP) |
| 65 | Not connected (CIP) |
| 68 | Connection establishing |
| 70 | Not connected (EPIC) |
| 77 | Scanner stopped |

# Local Slave or Connection I/O Value Diagnostics

## Introduction

Use the **I/O Values** page to display both the input data image and output data image for the selected local slave or connection.

Use the **Refresh Every 500ms** checkbox to display static or dynamic data, as follows:

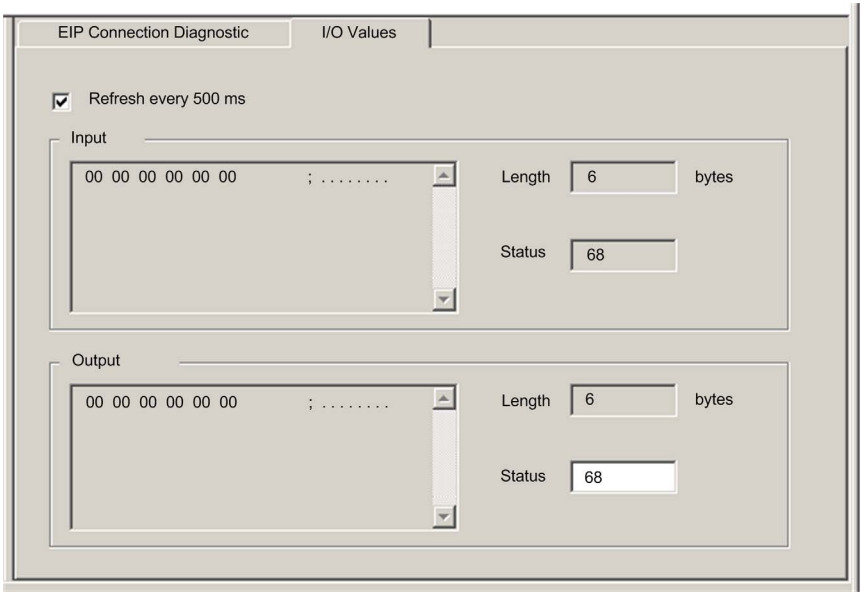
| When the checkbox is... | This page... |
|---|---|
| Selected | ● Displays data that is dynamically updated every 500 ms, and<br>● Increments the number at the top of the table each time data is refreshed |
| De-selected | ● Displays static data, and<br>● Does not Increment the number at the top of the table, which instead displays a constant value |

**NOTE:** Before you can open the **Diagnostic** window, connect the communication module or remote device DTM to the physical module or device. To do this, select the appropriate node in the **DTM Browser**, then select **Edit** →**Connect**.

To open this page:

| Step | Action |
|---|---|
| 1 | In the **DTM Browser**, select the communication module and click the right mouse button. A pop-up menu opens. |
| 2 | In the menu, select **Device menu** →**Diagnostic**. |
| 3 | In the left pane of the **Diagnostic** window, click on one of the following:<br>● the communication module node, or<br>● a connection node |
| 4 | Click on the **I/O Values** tab to open that page. |

The following example depicts the **I/O Values** page for a remote device connection:




## Local Slave / Connection I/O Values

This page displays the following parameters for either a local slave or a remote device connection input and output values:

| Parameter | Description |
|---|---|
| Input/Output data display | A display of the local slave or remote device input or output data image. |
| Length | The number of bytes in the input or output data image. |
| Status | The Scanner Diagnostic object's scanner status *(see page 249)*, with respect to the read of the input or output data image. |

# Logging

## Description

Unity Pro maintains a log of events for:

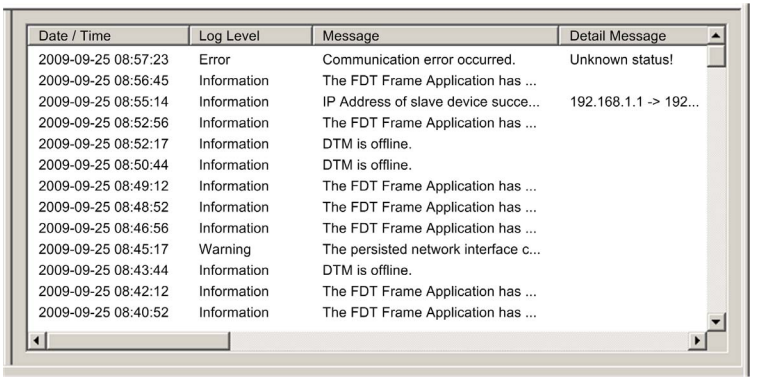
- the Unity Pro embedded FDT container
- each Ethernet communication module DTM, and
- each EtherNet/IP remote device DTM

Events relating to the Unity Pro FDT container are displayed in the **FDT log event** page of the **Output Window**.

Events relating to a communication module or remote EtherNet/IP device are displayed:

- in configuration mode: in the **Device Editor**, by selecting the **Logging** node in the left pane
- in diagnostic mode: in the **Diagnostics** window, by selecting the **Logging** node in the left pane

The following is a sample of the events log displayed in the **Diagnostics** window:



| Date / Time | Log Level | Message | Detail Message |
|---|---|---|---|
| 2009-09-25 08:57:23 | Error | Communication error occurred. | Unknown status! |
| 2009-09-25 08:56:45 | Information | The FDT Frame Application has ... | |
| 2009-09-25 08:55:14 | Information | IP Address of slave device succe... | 192.168.1.1 -> 192... |
| 2009-09-25 08:52:56 | Information | The FDT Frame Application has ... | |
| 2009-09-25 08:52:17 | Information | DTM is offline. | |
| 2009-09-25 08:50:44 | Information | DTM is offline. | |
| 2009-09-25 08:49:12 | Information | The FDT Frame Application has ... | |
| 2009-09-25 08:48:52 | Information | The FDT Frame Application has ... | |
| 2009-09-25 08:46:56 | Information | The FDT Frame Application has ... | |
| 2009-09-25 08:45:17 | Warning | The persisted network interface c... | |
| 2009-09-25 08:43:44 | Information | DTM is offline. | |
| 2009-09-25 08:42:12 | Information | The FDT Frame Application has ... | |
| 2009-09-25 08:40:52 | Information | The FDT Frame Application has ... | |

## Logging Attributes

The **Logging** window displays the result of an operation or function performed by Unity Pro. Each log entry includes the following attributes:

| Attribute | Description | |
|---|---|---|
| Date/Time | The time the event occurred, displayed in the format: yyyy-mm--dd hh:mm:ss | |
| Log Level | The level of event importance. Values include: | |
| | Information | A successfully completed operation. |
| | Warning | An operation that Unity Pro completed, but which may lead to a subsequent detected error. |
| | Error | An operation that Unity Pro was unable to complete. |
| Message | A brief description of the core meaning of the event. | |
| Detail Message | A more detailed description of the event, which may include parameter names, location paths, etc. | |

# Section 9.3
## CPU I/O Block Diagnostics

### Overview

The CPU's I/O Block contains diagnostic information relating to the operation of the BMX NOC 0401 Ethernet communication module. This information can be accessed in Unity Pro at runtime. This section describes the available I/O Block data, and how to access it.

### What Is in This Section?

This section contains the following topics:


| Topic | Page |
|---|---|
| Accessing the Unity Pro Diagnostic Tools | 333 |
| Communication Channel Diagnostics in Unity Pro | 335 |
| Communication Module Diagnostics in Unity Pro | 337 |

# Accessing the Unity Pro Diagnostic Tools

## Overview

The Unity Pro software provides diagnostic tools that let you view the:

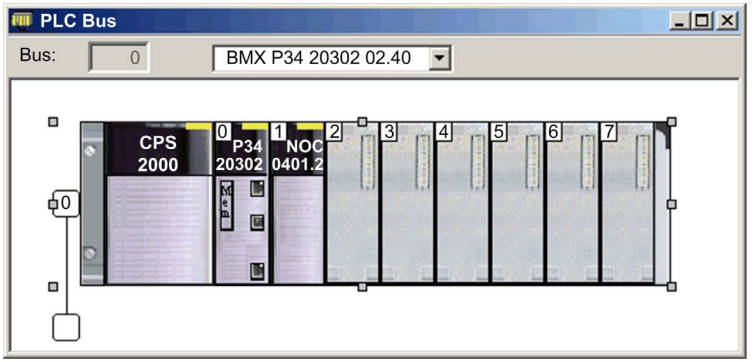
- communication module status
- communication module's:
  - detected faults
  - I/O objects
- communication channel's:
  - MAC Address
  - IP Address settings
  - detected faults

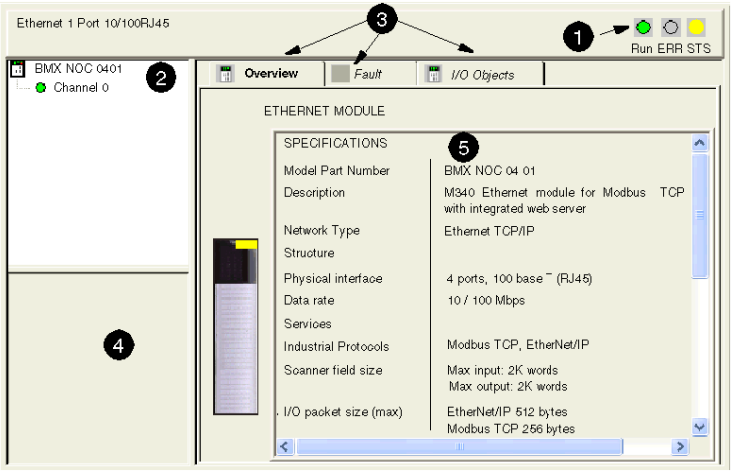
These Unity Pro diagnostic tools are available in the BMX NOC 0401 **Module Properties** window, only when Unity Pro is operating online.

**NOTE:** If the module and software are disconnected, use the Master DTM diagnostic screen in Unity Pro to check the I/O status.

## Accessing Unity Pro Diagnostic Tools

To access diagnostic tools for the Ethernet communication module:

| Step | Action |
|---|---|
| 1 | Open the Unity Pro project backplane diagram, below:   |

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td>2</td><td colspan="2">Do one of the following:<br>● double click the left mouse button on the communication module in the window above, or<br>● click the right mouse button on the communication module, then select Open Module... in the popup menu<br><br>The Ethernet Module window opens:<br> 
</td></tr>
<tr><td rowspan="5">3</td><td colspan="2">Navigate the Ethernet Module window using the following features:</td></tr>
<tr><td>1 Module status icons</td><td>These three indicators display the module’s status in online mode.</td></tr>
<tr><td>2 Channel area</td><td>Select a node to display parameters for either:<br>● the communication module, or<br>● a communication channel</td></tr>
<tr><td>3 Page tabs</td><td>Select a page to display module or channel properties:<br>● for the communication module:<br>  ● Overview<br>  ● Fault<br>  ● I/O Objects<br>● for a communication channel:<br>  ● Configuration<br>  ● Debug<br>  ● Fault</td></tr>
<tr><td>4 General parameters</td><td>View communication channel parameters:<br>● Function displays the configured communication function and is read-only.<br>● Task displays the task (configured MAST) and is read-only.</td></tr>
<tr><td>5 Mode parameters</td><td>Displays parameters for the mode you select by opening a page.</td></tr>
</table>

# Communication Channel Diagnostics in Unity Pro

## Overview

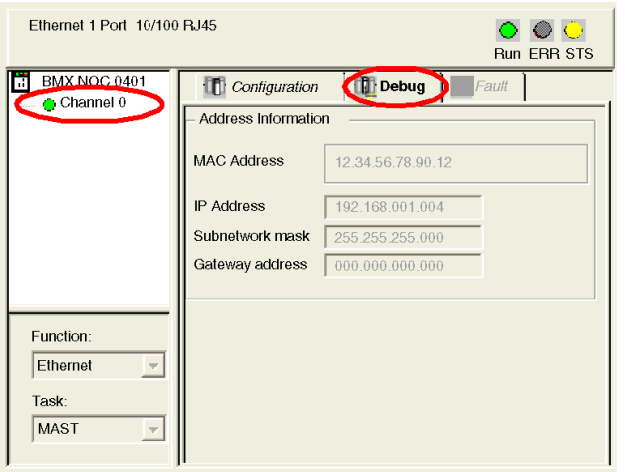
Select a communication channel in the **Channel area** to access the:

- **Configuration** page, where you can:
  - edit the EtherNet/IP Module name
  - edit input and output data size and location settings
  - launch the Unity Pro EtherNet/IP configuration tool

  Refer to the description of the **Configuration** page *(see page 36)* for more information.
- **Debug** page, which displays the communication module's:
  - MAC Address
  - IP Address settings
- **Fault** page, which displays active detected faults for the communication channel

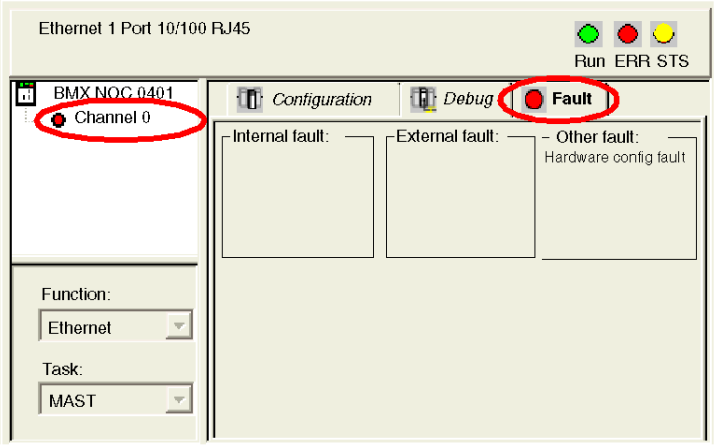
## MAC Address

To display the MAC Address of the communication module:

| Step | Action |
|---|---|
| 1 | In the **Channel area,** select the communication channel. The following pages are displayed:<br>● Configuration<br>● Debug<br>● Default |
| 2 | To display the communication module's MAC Address and IP Address settings, click on the **Debug** page:<br>  |

## Channel Detected Faults

To display the active faults detected on the communication channel:

| Step | Action |
|---|---|
| 1 | In the **Channel area,** select the communication channel. |
| 2 | To display the communication module's detected active faults, click on the **Fault** page:<br>  |

**NOTE:** You can also access the channel detected error bit (CH_ERROR) by using the Unity Pro **Animation Table** to display the **%Ir.m.ch.ERR** object.

# Communication Module Diagnostics in Unity Pro

## Overview

Use the Ethernet Module window in Unity Pro to diagnose the BMX NOC 0401 Ethernet communication module. In this window, you can access:

- three icons that reflect the current status of selected LEDs
- the **Overview** page, where you can view a description of the module
- **Fault** page, which displays detected active faults for the communication module
- **I/O Objects** page, where you can view and manage I/O objects for the module

## Module Status Icons

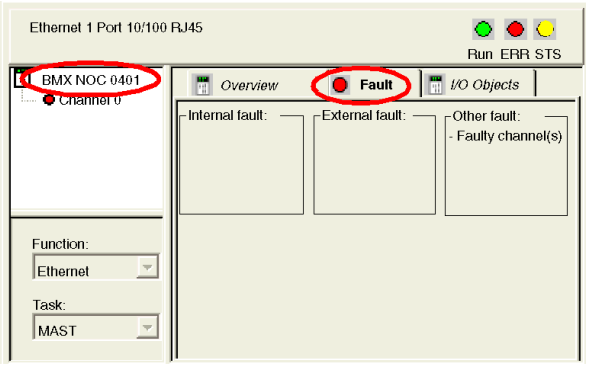
The Ethernet Module window displays three icons that reflect the current status of the following LEDs:

- Run
- ERR
- STS

Refer to the description of LED indicators *(see page 306)* for information on how to use these icons.

## Accessing Module Detected Faults

To display the detected active faults on the communication module:

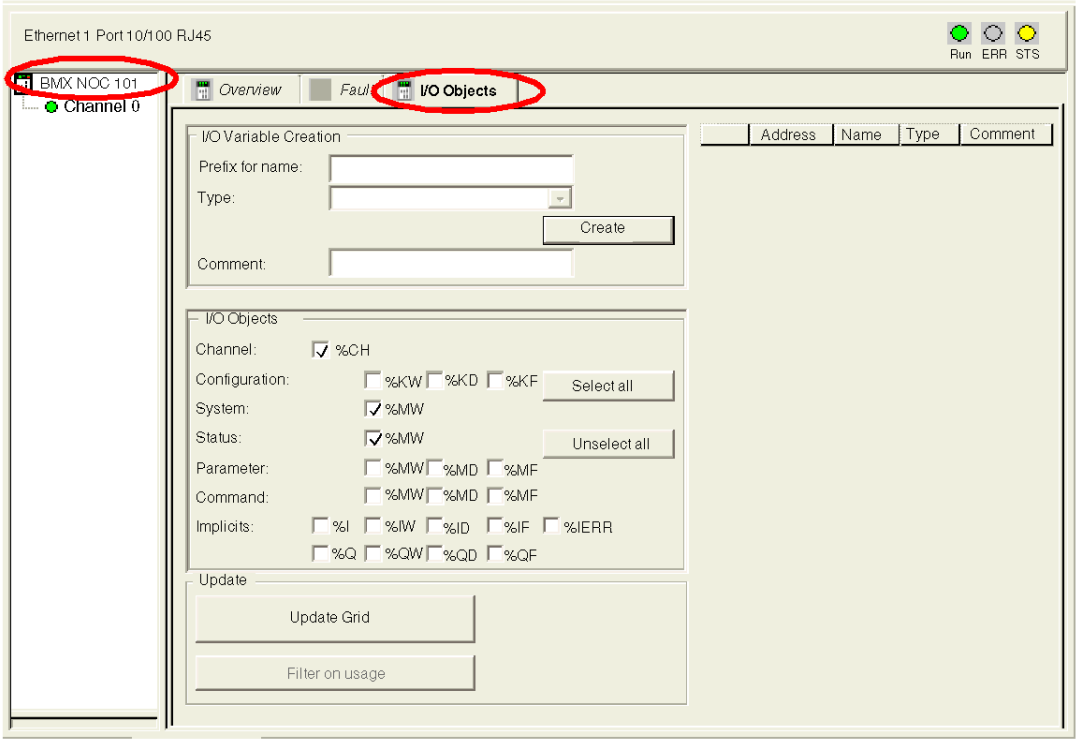
| Step | Action |
|---|---|
| 1 | In the **Channel area,** select the communication module. The following pages are displayed:<br>● Overview<br>● Fault<br>● I/O Objects |
| 2 | To display the communication module's active detected faults, click on the **Fault** page:<br>  |

**NOTE:** You can also access the module detected error bit by using the Unity Pro **Animation Table** to display the **%Ir.m.MOD.ERR** object.

## Managing I/O Objects

Use the I/O Objects page to view module I/O objects, and to manage the association of these objects with variables.

Open the **I/O Objects** page by selecting the **I/O Objects tab**, after the communication module has been selected in the **Channel area**:




**NOTE:**

- The BMX NOC 0401 communication module supports only Channel, System, and Status I/O Objects. Not every bit is used.
- Refer to the Unity Pro help for instructions on how to use the **I/O Objects** page.

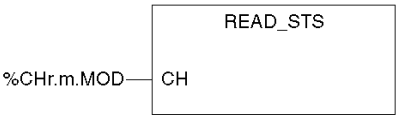
## Reading I/O Objects

Use a READ_STS function block in Unity Pro to update each of the following types of data:

- module data
- channel data

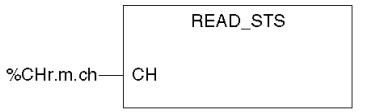
**Updating module data:**

To display module information, follow these steps:

| Step | Action | |
|---|---|---|
| 1 | Configure the READ_STS function block, as follows:<br>  <br>Where: | |
| | r = rack or station number | |
| | m = module or slot number | |
| | MOD = a constant indicating module data | |
| 2 | To view the data updated by the READ_STS function block, enter the corresponding direct addresses in the Unity Pro Animation table, or use them in your program logic: | |
| | **Object** | **Description** |
| | %Ir.m.MOD.ERR | Module detected error bit<br>%Ir.m.MOD.ERR is implicitly updated based on %Ir.m.0.ERR |
| | %MWr.m.MOD.0 | Exchange Status:<br>Bit 0: reading of module status in progress |
| | %MWr.m.MOD.1 | Exchange Report:<br>Bit 0: detected error while reading module status |
| | %MWr.m.MOD.2 | Bit 0: internal fault detected |
| | | Bit 1: operational fault detected |
| | | Bit 2: not used |
| | | Bit 3: self test |
| | | Bit 4: not used |
| | | Bit 5: configuration fault detected |
| | | Bit 6: missing module or off |
| | | Bit 7: not used |

**Updating channel data:**

To display channel information, follow these steps:

| Step | Action | | |
|---|---|---|---|
| 1 | Configure the READ_STS function block, as follows:<br>  <br><br>Where: | | |
| | r = rack, or station, number | | |
| | m = module, or slot, number | | |
| | ch = channel number—set to 0 for ETC transactions | | |
| 2 | To view the data updated by the READ_STS function block, enter the corresponding direct addresses in the Unity Pro Animation table, or use them in your program logic: | | |
| | **Object** | **Description** | **Standard Symbol** |
| | %Ir.m.ch.ERR | Channel detected error bit | CH_ERROR |
| | %Ir.m.ch.0 | Status of Ethernet services: | — |
| | | Bit 0: EIP Scanner (0 = OK, 1 = NOK) | — |
| | | Bit 1: EIP Adapter (0 = OK, 1 = NOK) | — |
| | | Bit 2: EIP Client (0 = OK, 1 = NOK) | — |
| | | Bit 3: EIP Server (0 = OK, 1 = NOK) | — |
| | | Bit 4: Modbus scanner (0 = OK, 1 = NOK) | — |
| | | Bit 5: Modbus TCP Client (0 = OK, 1 = NOK) | — |
| | | Bit 6: Modbus TCP Server (0 = OK, 1 = NOK) | — |
| | | Bit 7: FDR Server (0 = OK, 1 = NOK) | — |
| | | Bit 8: RSTP (0 = OK, 1 = NOK) | — |
| | | Bit 9–Bit 15: reserved | — |
| | %MWr.m.ch.0 | Exchange Status: | EXCH_STS |
| | | Bit 0: reading of status words of the channel in progress | STS_IN_PROG |
| | | Bit 1: command write in progress | CMD_IN_PROG |
| | %MWr.m.ch.1 | Exchange Report: | EXCH_RPT |
| | | Bit 0: detected error while reading channel status | STS_ERR |
| | | Bit 1: detected error while writing a command to the channel | CMD_ERR |

| Step | Action | | |
|---|---|---|---|
| 2 cont'd | %MWr.m.ch.2 | Standard channel status (low byte): | — |
| | | Bits 0...3: reserved (0) | — |
| | | Bit 4: internal fault detected | — |
| | | Bit 5: not used (0) | — |
| | | Bit 6: X-Bus communication fault detected | — |
| | | Bit 7: application fault detected (conf fault detected) | — |
| | | High byte: | — |
| | | Bits 0...7: reserved (0) | — |
| | %MWr.m.ch.3 | Ethernet Port Global Status: | ETH_PORT_STATUS |
| | | Bit 0: detected configuration error | — |
| | | Bit 1: the Ethernet interface is disabled | — |
| | | Bit 2: duplicate IP address detected | — |
| | | Bit 3: configuration mismatch | — |
| | | Bit 4: reserved | — |
| | | Bit 5: the module is in the process of obtaining an IP address | — |
| | | Bits 6...15: reserved | — |
| | %MWr.m.ch.4 | IP address (IP_ADDR): | IP_ADDR |
| | | • During normal operation, the double word %MDr.m.c.4 contains the IP address configured or served to the module. | — |
| | | • In No Configuration state, the double word %MDr.m.c.4 contains the default IP address of the module. | — |
| | | • In Configuration Error detected state, the double word %MDr.m.c.4 contains the default IP address of the module. | — |
| | | • When a duplicate IP address is detected, the double word %MDr.m.c.4 contains the served or configured duplicate IP address. | — |
| | | • When the module is waiting for a BOOTP response, the double word %MDr.m.c.4 contains the IP address 0.0.0.0. | — |

# Chapter 10
# Replacing the Ethernet Communication Module

## Replacing the Ethernet Communication Module

### Overview

Replacing The module involves removing the old module and mounting a new one in its place

### When to Replace

You can replace the communication module at any time using another module with compatible firmware. A module can be replaced when power to the module is either:

- off (cold swap), or
- on (hot swap)

The replacement module obtains its operating parameters over the backplane connection from the CPU. The transfer occurs either immediately (hot swap) or when power is next cycled to the device (cold swap).

**NOTE:** Operating parameters, that were added to the configuration using explicit messaging “SET” commands, are not included in the parameters that the CPU sends to a replacement module.

To install the replacement module, follow the instructions in the module mounting procedure *(see page 21)*.

# Chapter 11
# Embedded Web Pages

## Overview

This chapter describes the embedded web pages for the BMX NOC 0401 Ethernet communication module.

The communication module includes a Hypertext Transfer Protocol (HTTP) server. The server transmits web pages for the purpose of monitoring, diagnosing, and controlling remote access to the communication module. The server provides easy access to the communication module from standard internet browsers, including—but not limited to—Internet Explorer.

## What Is in This Chapter?

This chapter contains the following sections:


| Section | Topic | Page |
|---|---|---|
| 11.1 | Accessing the Embedded Web Server | 346 |
| 11.2 | Monitoring the Unity Pro Application | 354 |
| 11.3 | Diagnostics | 366 |

# Section 11.1
## Accessing the Embedded Web Server

### Introduction

This section introduces the BMX NOC 0401 communication module's embedded web server, and describes how to access—and to control access to—the web pages.

### What Is in This Section?

This section contains the following topics:


| Topic | Page |
|---|---|
| Introducing the Embedded Web Pages | 347 |
| Accessing the Home Page | 348 |
| Using and Editing a Username and Passwords | 349 |
| Configuring Port Mirroring | 352 |

# Introducing the Embedded Web Pages

## Introduction

Use the BMX NOC 0401 Ethernet communication module's embedded web server pages to:

- display real-time diagnostic data for both the module and other networked devices
- read the values of—and write values to—Unity Pro application variables
- manage and control access to the embedded web pages by assigning separate passwords for:
  - viewing the diagnostic web pages, and
  - using the Data Editor to write values to Unity Pro application variables

## Requirements

The embedded web server presents module data in the form or standard HTML web pages. Access the embedded web pages using Internet Explorer version 4.0 or higher, running the Java Runtime Environment (JRE) version 1.6 or higher.

# Accessing the Home Page

## On First Use

Before you begin to use the BMX NOC 0401 communication module's embedded web pages, you need to:

- navigate to the web server
- access web page content by inputting the default username and password *(see page 349)* combination
- change passwords *(see page 350)* that are required for:
  - accessing web pages, and
  - writing data values using the **Data Editor**

## Navigating to the Web Server

To access the embedded web server, open an Internet browser, then enter the IP address *(see page 65)* of the Ethernet communication module in the format: *http:///IP address*, then click **Enter**.

**NOTE:** If a DNS name has been assigned to the module, the DNS name can be used instead of the IP address.

The web server opens, displaying the **Home** page:

Use the **Home** page as the point of entry to the communication module's embedded web server. From here, you can navigate to every other web page.

# Using and Editing a Username and Passwords

## Inputting the Username and Web Page Access Password

A username and password are required to access web page content and edit application data. All username and password settings are case sensitive.

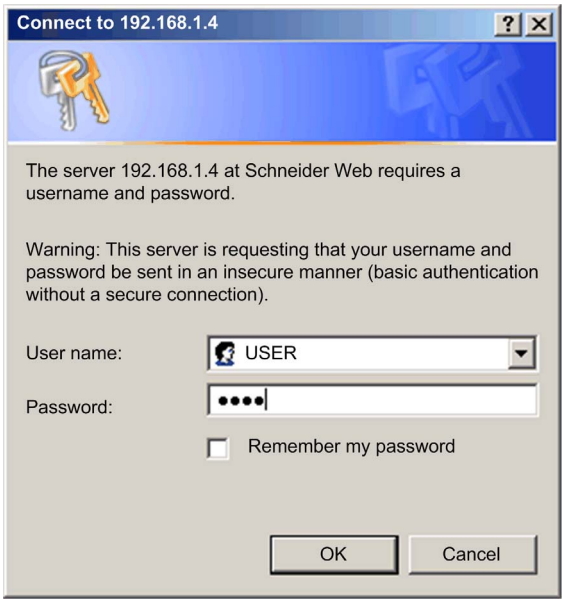
The embedded web pages support the use of a single, editable username for both web page access and data editing. The factory-default username setting is **USER**.

The embedded web pages require two different passwords, as follows:

- an HTTP access password, which grants read-only access to web page content
- a data editor write password, which permits the editing of data values using the **Data Editor**

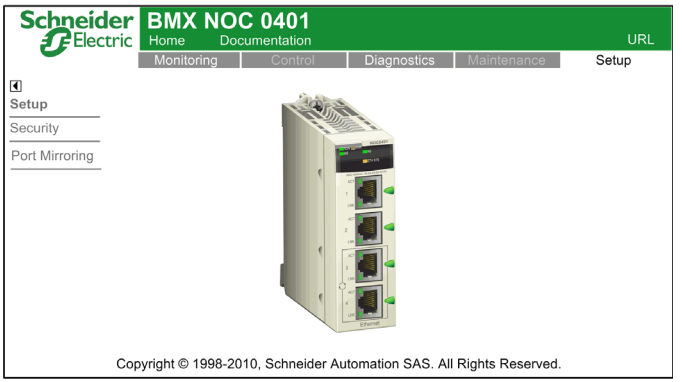
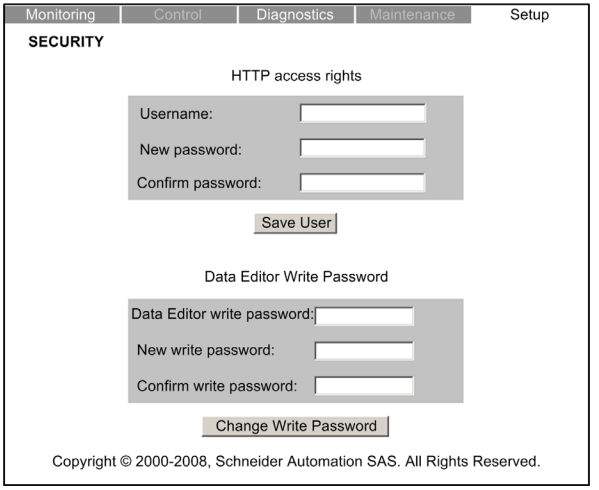
Each password can be edited. The factory default setting for each password is **USER**.

To input a username and password combination

| Step | Description |
|---|---|
| 1 | After navigating to the embedded web server *(see page 348)*, select one of the main menu selections (for example, **Setup**). |
| 2 | Select a page name from the list of pages on the left side of the page (for example, **Security**). The following dialog opens:<br>  |
| 3 | Type in the required **Username** and **Password** combination, then click **OK**.<br>**NOTE:** In the above example, the settings for both the Username and Password remain set to the default setting of USER. |

## Editing the Username and Passwords

The single username and both passwords can be edited in the **Security** web page. To edit username and passwords, follow these steps:

| Step | Description |
|---|---|
| 1 | Navigate to and open the web server, *(see page 348)* using the IP address of the communication module. The **Home** page opens. |
| 2 | From the **Home** page, click on the **Setup** main menu item. If required, input the username and web page password *(see page 349)*.<br>The **Setup** page opens:<br>  |
| 3 | On the left side of the page, click on the **Security** node. (If required, input the **Username** and web page access **Password**.)<br>The **Security** page opens:<br>  |

| Step | Description | |
|---|---|---|
| 4 | To change the username and password combination used for web page access, in the **HTTP access rights** section of the page, enter values for the following fields: | |
| | Username: | ● To change the username: type in a new username<br>● To retain the current username (for example, if you are changing only the password): type in the current username |
| | New password: | ● To change the password: type in a new password<br>● To keep the current password (for example, if you are changing only the username): type in the current password |
| | Confirm password: | Type in the same password entered in the **New password** field, above. |
| 5 | Click the **Save User** button. | |
| 6 | To change the password used for writing data values in the **Data Editor**, in the **Data Editor Write Password** section of the page, enter values for the following fields: | |
| | Data Editor write password: | Type in the current password that is required to write data using the **Data Editor**. |
| | New write password: | Type in the new **Data Editor** password. |
| | Confirm write password: | Type in the same password entered in the **New write password** field, above. |
| 7 | Click the **Change Write Password** button. | |

# Configuring Port Mirroring

## Enabling Port Mirroring in Unity Pro

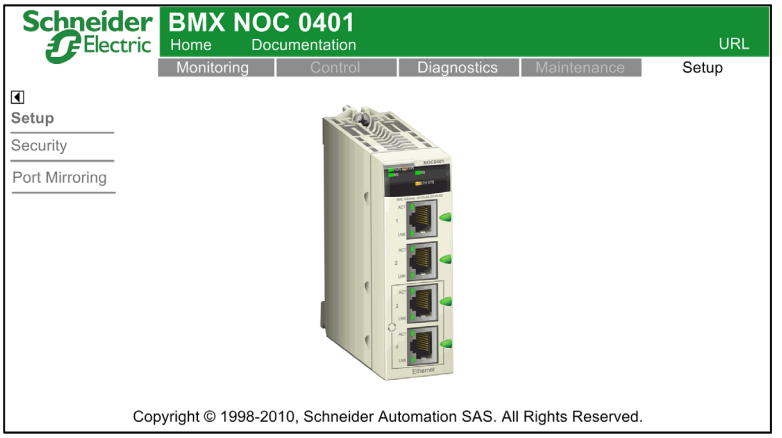
You can use the port mirroring service to duplicate the traffic entering and exiting any one of the four Ethernet ports (the source port) onto another one of the ports (the destination port), for the purpose of diagnosing the source port.

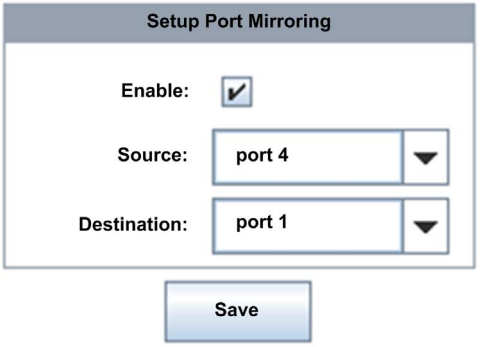
**NOTE:**

- Verify that the port mirroring service is enabled in Unity Pro *(see page 73)* before configuring it in the web pages.
- You can designate only non-RSTP enabled ports as the destination port.
- The port mirroring configuration settings are transient, and are cleared when you reboot the Ethernet communication module.

## Configuring Port Mirroring in the Web Pages

To configure port mirroring, follow these steps:

| Step | Description |
|---|---|
| 1 | In Unity Pro, enable the port mirroring service *(see page 73)* to globally enable port mirroring. |
| 2 | Navigate to and open the web server, *(see page 348)* using the IP address of the communication module. The **Home** page opens. |
| 3 | From the **Home** page, click on the **Setup** main menu item. If required, input the username and web page password *(see page 349)*. The **Setup** page opens:   |

| Step | Description | |
|---|---|---|
| 4 | On the left side of the page, click on the **Port Mirroring** node. The **Port Mirroring** page opens:<br>  | |
| 5 | Configure the following fields: | |
| | Enable: | Place a check mark in this field to enable port mirroring. (Default = de-selected.) |
| | Source: | Select a port (1...4). The traffic from this port will be duplicated and sent to the destination port for diagnosis. |
| | Destination: | Select a port—other than the source port—to receive the duplicated traffic of the source port. Only ports with RSTP disabled can be selected. |
| 6 | Click the **Save** button. | |

# Section 11.2
## Monitoring the Unity Pro Application

### Overview

This section describes how to use the BMX NOC 0401 Ethernet communication module's embedded web pages to monitor the Unity Pro application.

### What Is in This Section?

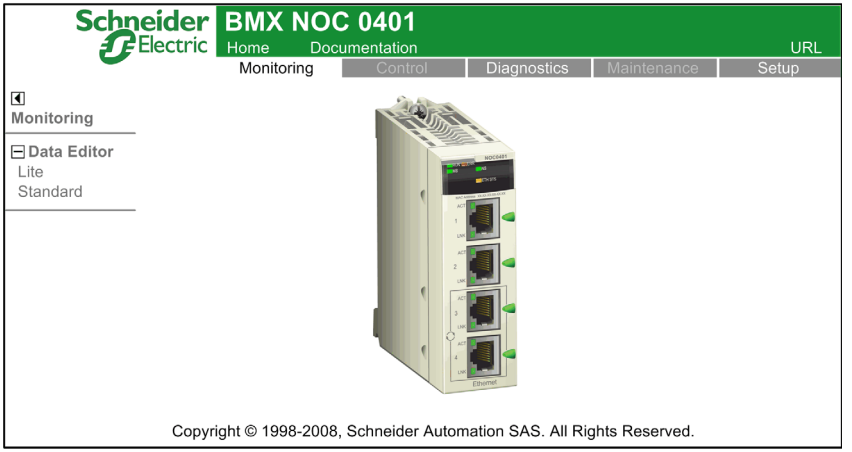
This section contains the following topics:


| Topic | Page |
|---|---|
| Using the Monitoring Page | 355 |
| Data Editor (Standard) | 356 |
| Working With Data Templates | 361 |
| Data Editor (Lite) | 365 |

# Using the Monitoring Page

## Monitoring Page

Click on the main menu **Monitoring** command to display the **Monitoring** page:




To access a monitoring service, click on either of the following links:

- **Data Editor Lite**
- **Data Editor Standard**

# Data Editor (Standard)

## Overview

The **Data Editor** is a Java applet that dynamically displays run-time application data. Use the **Data Editor** to create and edit data monitoring tables that provide read/write access to application data and device registers.

**NOTE:** Write access is password protected.

**⚠ WARNING**

**Unintended Equipment Operation**

The data editor makes it possible to write to application variables and change application data values.

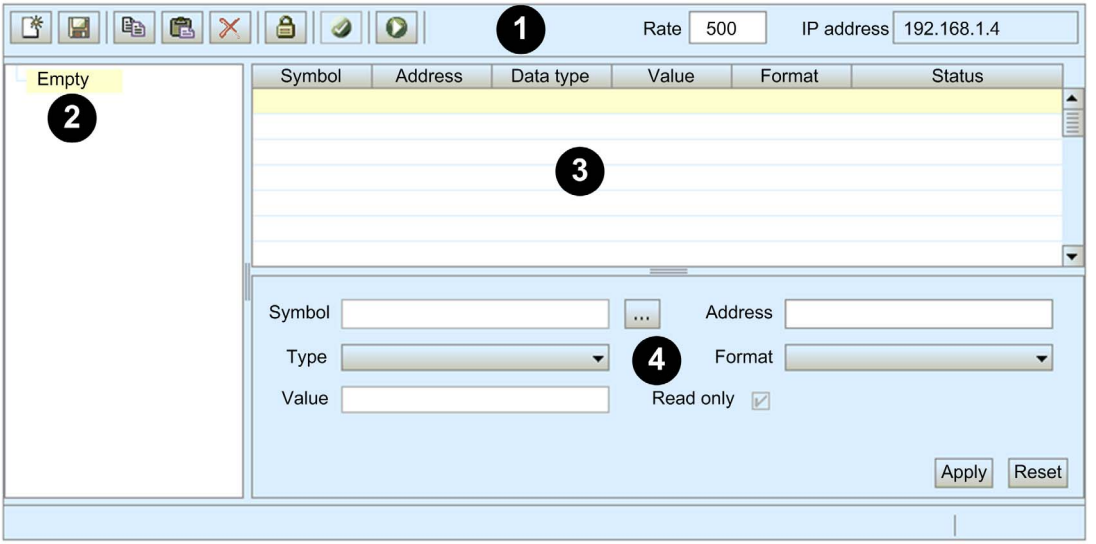
- Use passwords to strictly limit access to write data functionality.
- Do not use weak passwords, including the default password and other obvious passwords.
- Limit access to trained personnel.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

This topic describes the **Data Editor** user interface.

## Data Editor

The **Data Editor** presents the following controls:




**1** Toolbar
**2** Data template list
**3** Data template
**4** Configuration Area

## Toolbar

The **Data Editor** toolbar presents the following features:

| Command or Field | Icon | Description |
|---|---|---|
| New | | • If a node in the data template list is selected, this command opens the **New table** dialog for the creation of a new data template. The new data template is inserted below the selected node.<br>• If a row in the currently open data template is selected, this command inserts a new row below the selected row. |
| Save | | Saves changes made to both the data template list and each data template. |
| Copy | | • If a node in the data template list is selected, this command copies the selected data template.<br>• If an item (or row) in the currently open data template is selected, this command to copies the selected item. |

| Command or Field | Icon | Description |
|---|---|---|
| Paste | | • If the root, or Empty, node is selected in the data template list, this command pastes a previously copied data template into the list.<br>• If an empty item (or row) in the currently open data template is selected, this command pastes a previously copied item into the data template item at the selected row.<br>**NOTE:** When adding a copied item, or row, to a data template, the paste command will overwrite item data in the selected row. To insert a copied row between existing rows, first use the **New** command to create an empty row, then paste the copied data into the new row. |
| Delete | | Deletes the selected data template from the list, or the selected item from the data template. |
| Change password | | Opens the **Change password** dialog, where you can change the Data Editor Write *(see page 350)* password.<br>**NOTE:** The Data Editor Write password can also be changed in the **Setup** →**Security** web page. |
| Read PLC symbols | | Loads the existing Unity Pro symbol—or variable—names into the **Lookup Variable** dialog. Variables that have been loaded into this dialog can be added to the currently open data template. |
| Start animation | | Starts the dynamic display of value and status for the items contained in the selected data template.<br>**NOTE:** The Start animation icon is visible only when animation is turned OFF. |
| Stop animation |  | Stops the dynamic display of value and status for the items contained in the selected data template.<br>**NOTE:** The Stop animation icon is visible only when animation is turned ON. |
| Rate | — | The refresh rate of the dynamic display of data template items, in milliseconds. |
| IP address | — | The IP address of the Ethernet communication module and its embedded web server. |

## Data Template List

The data template list displays a node for each data template that was either:

- previously saved, or
- created after the **Data Editor** was opened, but not yet saved

Select a data template in this list to view or edit its contents.

**NOTE:** If you create a new data template, then navigate away from the **Data Editor** before clicking the **Save** button, the new data template will be lost.

## Data Template

Use the data template—when animation is turned ON—to monitor the status and values of items for the template that is currently selected in the data template list.

Each data template item (or row) is defined in the configuration area. A data template item can contain the following fields:

| Field | Description | |
|---|---|---|
| Symbol | Contains the names of Unity Pro symbols (variables). | |
| Address | Contains direct addresses and the addresses of Unity Pro symbols (variables). Any direct address can be viewed by entering its reference in this field. Valid direct addresses include: | |
| | %Mi | same as for 0X coils |
| | %Ii | same as 1x for discreet inputs |
| | %IWi | same as 3x for input registers |
| | %MWi, %MDi, %MFi | same as 4x for holding registers |
| | **NOTE:**<br>● A single bit of any word address (for example, %MWi, %IWi) can be specified by appending ".j" to the address, where "j" is a bit index in the range of 0 (LSB) to 15 (MSB). For example, bit 4 of the value at %MW101 would be specified as %MW101.4.<br>● A direct address can include an index specification that allows it to be treated as an array variable. Indexed addressing can be used with a %Mi, %MWi, %MDi, or %MFi address by appending "[j]" to the address of the beginning of the array, where "j" is an unsigned integer value. For example, the third value of an array of float values starting at %MF201 would be specified as %MF201[2]. | |
| Data type | Contains the data type of the symbol (variable) or direct address. Symbol (variable) data types appear automatically when the symbol (variable) is located. Select direct address data types from a drop-down list. The following data types are valid: | |
| | INT | 16-bit signed integer |
| | UINT | 16-bit unsigned integer |
| | DINT | 32-bit signed integer |
| | UDINT | 32-bit unsigned integer |
| | REAL | 32-bit IEEE floating point |
| | TIME | 32-bit unsigned integer (in ms) |
| | DATE | Date (32-bit BCD) |
| | TOD | Time of day (32-bit BCD) |
| | BOOL | 1 bit discrete (Boolean) |
| Value | When animation has started, this field displays the value of the symbol (variable) or direct address. This field is updated continuously. | |

| Field | Description | |
|---|---|---|
| Format | Contains the format type for displaying the value of the symbol (variable) or direct address. The following formats are available: | |
| | bool | Boolean |
| | dec | Decimal |
| | hex | Hexadecimal |
| | binary | Binary |
| | ASCII | bytes displayed as ASCII characters |
| | time | day_hr_min_sec_ms |
| | date | YYYY-MM-DD or HH:MM:SS |
| Status | Contains messages describing the status of communication with the symbol (variable) or direct address: | |
| | if communication is normal | The status message reads **OK** |
| | if communication is interrupted | The status field displays a system message describing the interruption |

## Configuration Area

Open and close the configuration area by double-clicking on a row in the data template. The configuration area will display the configuration settings for the selected row. Use the up and down arrows on your keyboard to move between rows in the data template and display their settings in the configuration area.

Use the configuration area—when data template animation is turned OFF—to:

- create a new data template *(see page 361)*
- display the items contained in an existing data template *(see page 362)*
- add items to a data template, including:
  - inserting a symbol *(see page 363)* (or variable) to a data template
  - inserting a direct address *(see page 363)* to a data template

Use the configuration area—when data template animation is turned ON—to write data to read/write application variables.

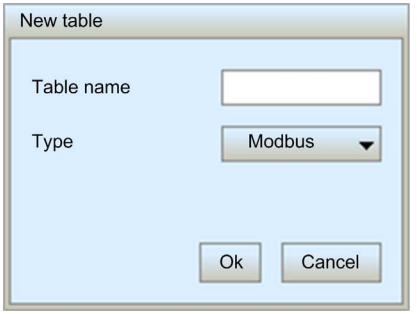
Refer to the topic Working With Data Templates for more information on how to use the controls in the configuration area.

# Working With Data Templates

## Creating a Data Template

To display and access application data, first create a data template.

To create a new data template, follow these steps:

| Step | Description |
|---|---|
| 1 | Confirm that **Data Editor** animation is OFF. If necessary, click the **Stop animation** toolbar button. |
| 2 | Click the **New** table toolbar button.<br>The **New table** dialog opens:<br>  |
| 3 | In the **Table name** field, type in the name of the new data template. |
| 4 | Click **Ok**.<br>The new data template appears as a node in the data template list. |

**NOTE:** Save the new data template before performing any other task in the **Data Editor**. Moving to another page—or creating a new data template in the current page—before saving your work deletes the new data template.

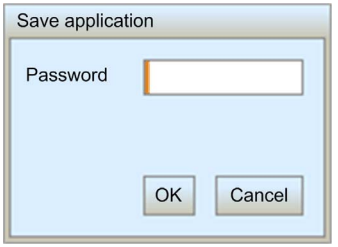
## Saving a Data Template

After you save a new data template, you can re-use it to view or modify its contents.

**NOTE:**

- Be careful when you modify and save a data template. The last saved modification overwrites the pre-existing data template, even if the data template was originally created by someone other than yourself.
- If a data template is open for viewing by someone else, your edits to that data template will be seen only when that person next accesses the **Data Editor**.

To save a new data template, follow these steps:

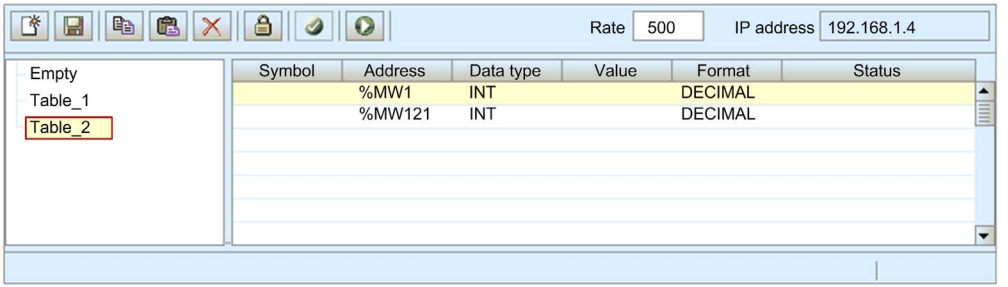
| Step | Description |
|---|---|
| 1 | Click the **Save** toolbar button.<br>The **Save application** dialog opens:<br>  |
| 2 | In the **Password** field, type in the **Web Page (HTTP) Access** password.<br>**NOTE:** The default password is **USER**. |
| 3 | Click **Ok**.<br>The new data template is saved. |

## Displaying an Existing Data Template

When you open a saved data template, you can use it to:

- edit its contents by inserting either a variable or a direct address
- monitor the value and status of data items
- write data values to a read/write variables

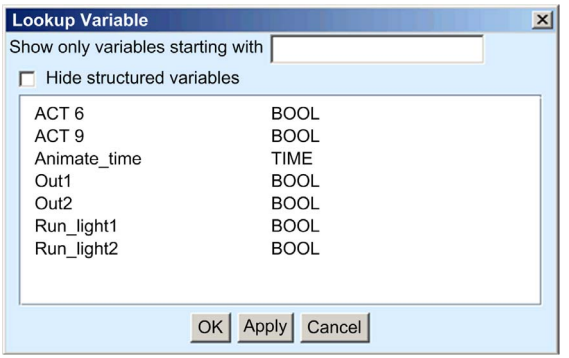
The data template list, located on the left side of the **Data Editor**, displays the saved data templates. Select a data template node from the list to display that template's data items in the spreadsheet on the right:



## Inserting a Symbol (Variable) Into a Data Template

You can add Unity Pro variables—also called symbols—into a data template. After a variable is added, you can view or modify its value.

To add a symbol to a data template, follow these steps:

| Step | Description |
|---|---|
| 1 | In the data template spreadsheet, double-click on an empty row.<br>The **Data Editor** configuration area opens. |
| 2 | In the configuration area, click on the ellipsis button (...).<br>The **Lookup Variable** dialog opens:<br>  |
| 3 | Select the variable (symbol) you want to add to your data template. |
| 4 | Click **OK**.<br>The variable name is displayed in the **Symbol** field of the row selected in the data template. |
| 5 | In the configuration area, click **Apply**. The selected row is updated. |
| 6 | **Save** your edits. |

## Inserting a Direct Address Into a Data Template

You can add Unity Pro direct address items—also called located registers—into a data template. After a direct address item is added, you can view or modify its value.

To add a direct address item to a data template, follow these steps:

| Step | Description |
|---|---|
| 1 | In the data template spreadsheet, double-click on an empty row.<br>The **Data Editor** configuration area opens. |
| 2 | In the **Address** field of the configuration area, type in the item's direct address. |
| 3 | In the configuration area, click **Apply**. The selected row is updated. |
| 4 | **Save** your edits. |

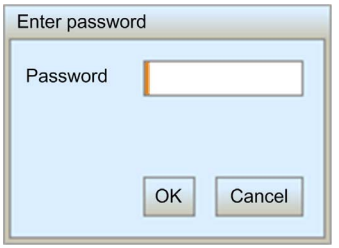
## Modifying Data Values Using a Data Template

You can use the **Data Editor** to write data values to a variable (symbol) or to a direct address item, and send the new value to the controller.

For example, suppose that you have programmed a pushbutton object to jog a motor when the button is depressed and to stop jogging when the button is released. If communications are lost while the button is depressed, the motor will continue to jog even when the button is released. Graphic objects are not designed to be used to control situations like this, unless other interlock methods are installed in the system.

**NOTE:** You can only modify the value of data items that are defined as read/write in the Unity Pro application.

To use the **Data Editor** to edit data, follow these steps:

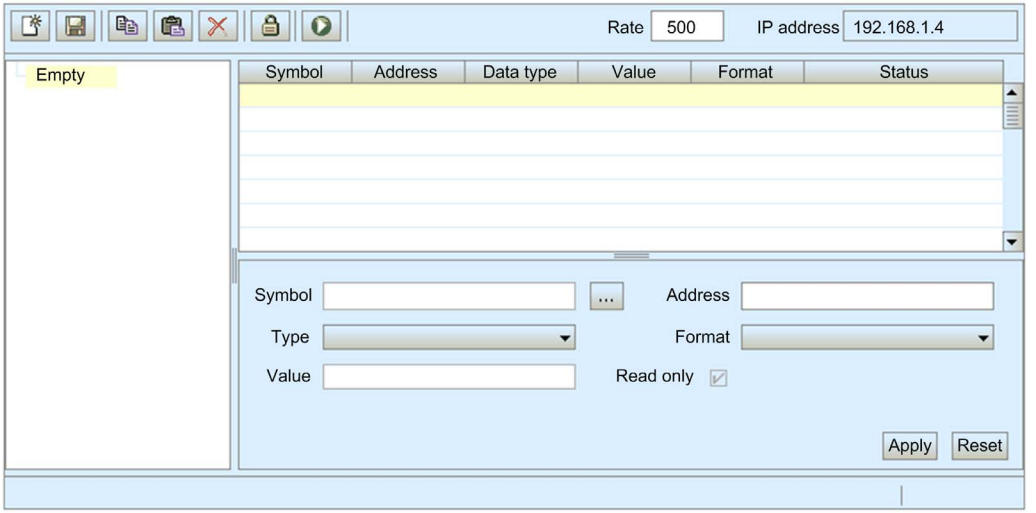
| Step | Description |
|---|---|
| 1 | In the data template spreadsheet, double-click on the item you want to write data to.<br>The **Data Editor** configuration area opens, displaying the fields for the selected item. |
| 2 | In the **Value** field, type in the desired data value. |
| 3 | Click **Apply**.<br>The **Enter password** dialog opens:<br>  |
| 4 | In the **Password** field, type in the Write Data password.<br>**NOTE:** The default password is **USER**. |
| 5 | Click **OK**. The new value is sent to the controller. |

# Data Editor (Lite)

## Overview

**Data Editor Lite** is a version of the **Data Editor** that is smaller in size and therefore faster to download, especially for use via a dial-up connection.

**Data Editor Lite** presents the same interface as the **Data Editor**, with the exception that its toolbar does not include the **Read PLC Symbols** function:




## Variables

**Data Editor Lite** accepts the following IEC variables:

| Address | Type | Display |
|---|---|---|
| %MW IEC internal word | INT | DECIMAL |
| %MD IEC double word | DINT | DECIMAL |
| %M IEC internal bits | BOOL | BOOLEAN |

**NOTE:** You cannot access the **Lookup Variable** dialog and insert symbols into a data template using **Data Editor Lite**. You can insert only direct addresses.

## Re-Using Data Editor Templates

**Data Editor Lite** can reuse the same templates created with the **Data Editor**. However, **Data Editor** templates can use a wider range of variable types than **Data Editor Lite**. When **Data Editor Lite** encounters a variable it cannot manage, it displays `Not Supported` as the data type. In this case, the variable cannot be edited using **Data Editor Lite**.

# Section 11.3
# Diagnostics

## Overview

This section describes the diagnostic services provided by the BMX NOC 0401 Ethernet communication module.

## What Is in This Section?

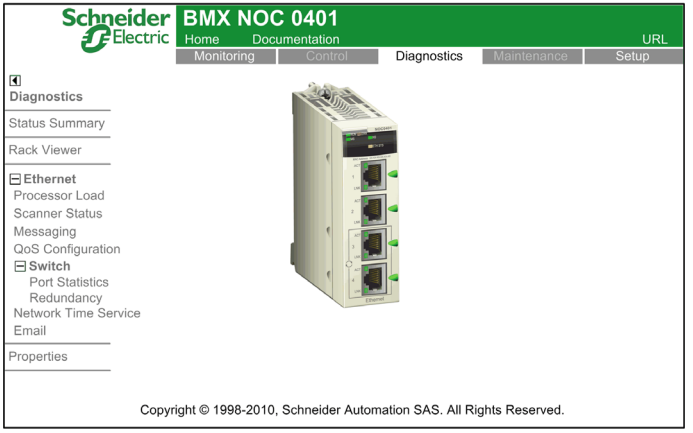
This section contains the following topics:


| Topic | Page |
|---|---|
| Using the Diagnostics Page | 367 |
| Status Summary | 368 |
| Rack Viewer | 371 |
| Processor Load | 373 |
| Scanner Status | 375 |
| Messaging | 377 |
| QoS Configuration | 379 |
| Port Statistics | 380 |
| Redundancy | 382 |
| Email Diagnostics | 383 |
| Network Time Service Diagnostics | 385 |
| Properties | 387 |

# Using the Diagnostics Page

## Diagnostics Page

Click on the main menu **Diagnostics** command to display the **Diagnostics** page:




To access a monitoring service, click on either of the following links:

- Status Summary *(see page 368)*
- Rack Viewer *(see page 371)*
- Ethernet:
  - Processor Load *(see page 373)*
  - Scanner Status *(see page 375)*
  - Messaging *(see page 377)*
  - QoS Configuration *(see page 379)*
- Switch
  - Port Statistics *(see page 380)*
  - Redundancy *(see page 382)*
- Network Time Service *(see page 385)*
- Email *(see page 383)*
- Properties *(see page 387)*

# Status Summary

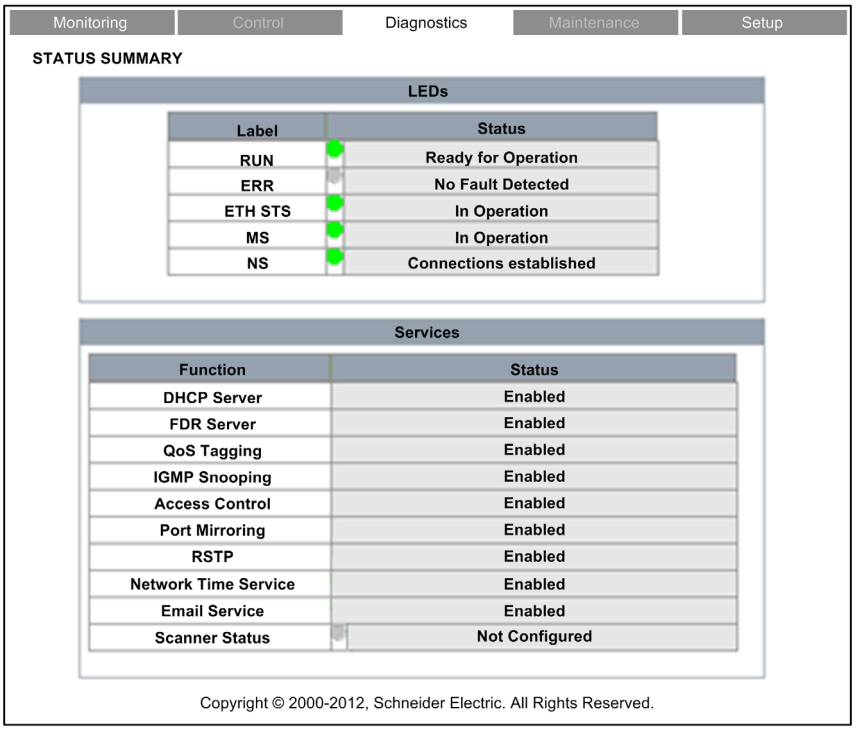
## Introduction

Use the **Status Summary** page to view the status of:

- the LEDs *(see page 306)* located on the front of the BMX NOC 0401 Ethernet communication module
- the Ethernet services *(see page 73)* supported by the communication module
- the communication module in its role as:
  - scanner
  - Modbus TCP server
  - EtherNet/IP messaging server

## Status Summary Display

The **Status Summary** page looks like this:



To open this page:

| Step | Action |
|---|---|
| 1 | Starting at the **Home page**, click the **Diagnostics** main menu item. The **Diagnostics** page opens. |
| 2 | On the left side of the **Diagnostics** page, select **Ethernet** →**Status Summary**. |
| 3 | If necessary, type in the HTTP web access password.<br>**NOTE:** The default password is **USER**. |

## Status Summary Data

The **LEDs** section of the page can present the following operational states:

| LED | Color | Text Descriptions |
|---|---|---|
| RUN | Green | Ready for operation |
| | Gray | Not ready for operation |
| ERR | Red | Fault detected |
| | Gray | No fault detected |
| ETH STS | Green | In operation |
| | Red | Duplicate IP |
| | | Waiting for BootP server response |
| | | Default IP Address in use |
| | | IP Address Configuration conflict detected |
| MS (module status) | Green | In operation |
| | Red | Not configured |
| | | Fault detected |
| | | Recoverable fault detected |
| NS (network status) | Green | Connections established |
| | Red | No EtherNet/IP connections |
| | | Connection error detected |
| | | Duplicate IP address |

The **Services** section of the page can present the following functional conditions:

| Function | Color | Text Descriptions |
|---|---|---|
| DHCP Server | — | Enabled |
| FDR Server | | Disabled |
| QoS Tagging | | |
| IGMP Snooping | | |
| Access Control | | |
| Port Mirroring | | |
| RSTP | | |
| Network Time Service | — | Enabled |
| Email Service | | Disabled |
| Scanner Status | Green | Working properly |
| | Red | At least one connection is bad |
| | Gray | Not configured |

# Rack Viewer

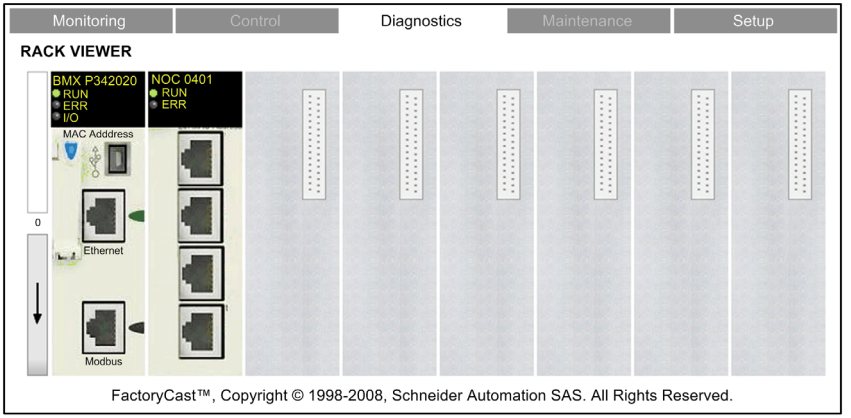
## Introduction

Use the **Rack Viewer** to access web pages that describe the identity, placement, configuration and operation of modules in the M340 rack.

To view information describing a specific module—including the BMX NOC 0401 Ethernet communication module—click on the image of that module in the **Rack Viewer**.

## Rack Display

The **Rack Viewer** looks like this, when it is first opened:

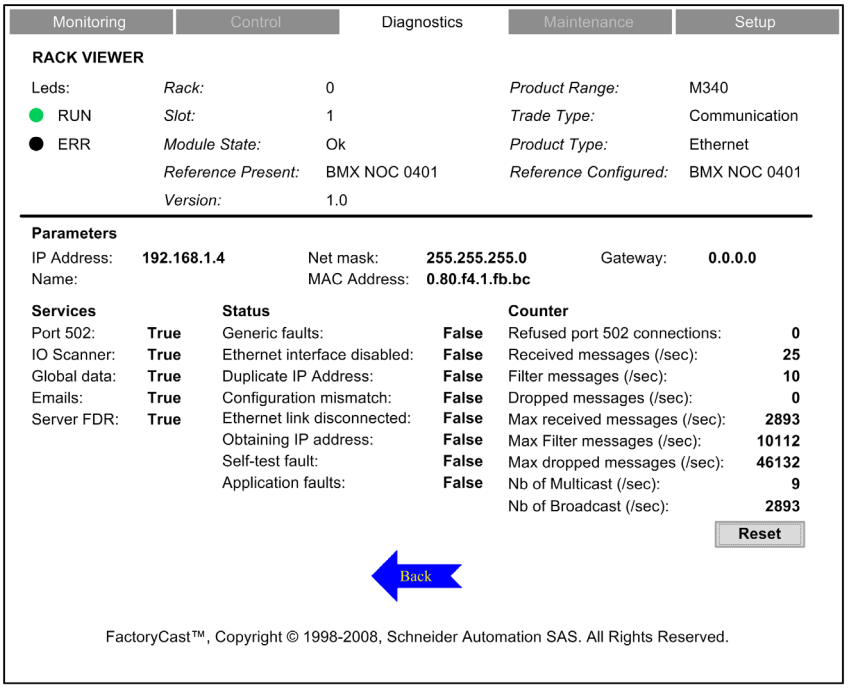



To open this page:

| Step | Action |
|---|---|
| 1 | Starting at the **Home page**, click the **Diagnostics** main menu item. The **Diagnostics** page opens. |
| 2 | On the left side of the **Diagnostics** page, select **Rack Viewer**. |
| 3 | If necessary, type in the HTTP web access password.<br>**NOTE:** The default password is **USER**. |

## Rack Viewer Displaying the BMX NOC 0401

When you click on the BMX NOC 0401 in the rack display, the following web page opens:




Click on the blue **Back** arrow to return to the rack display.

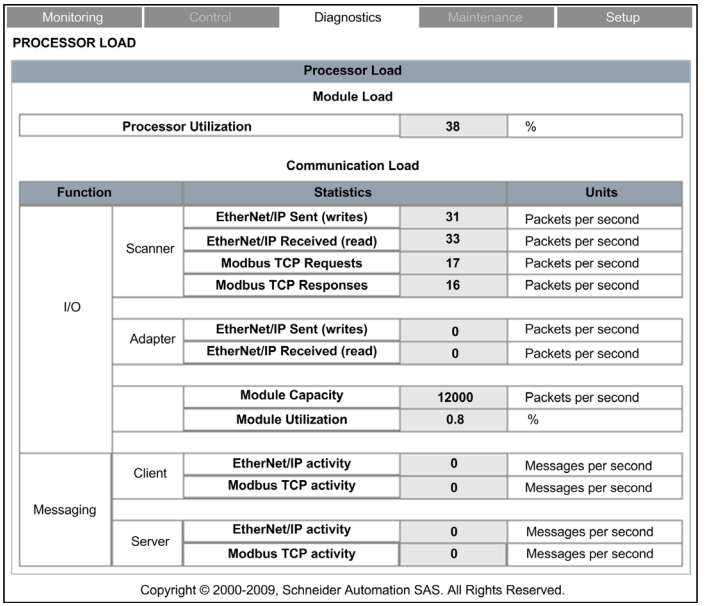
# Processor Load

## Introduction

Use the **Processor Load** web page to display dynamically generated data for the BMX NOC 0401 communication module's bandwidth usage.

## Processor Load Display

The **Processor Load** page looks like this:



Monitoring | Control | Diagnostics | Maintenance | Setup

**PROCESSOR LOAD**

**Processor Load**

**Module Load**

| | | |
|---|---|---|
| **Processor Utilization** | **38** | % |

**Communication Load**

| Function | | Statistics | | Units |
|---|---|---|---|---|
| I/O | Scanner | **EtherNet/IP Sent (writes)** | **31** | Packets per second |
| | | **EtherNet/IP Received (read)** | **33** | Packets per second |
| | | **Modbus TCP Requests** | **17** | Packets per second |
| | | **Modbus TCP Responses** | **16** | Packets per second |
| | Adapter | **EtherNet/IP Sent (writes)** | **0** | Packets per second |
| | | **EtherNet/IP Received (read)** | **0** | Packets per second |
| | | **Module Capacity** | **12000** | Packets per second |
| | | **Module Utilization** | **0.8** | % |
| Messaging | Client | **EtherNet/IP activity** | **0** | Messages per second |
| | | **Modbus TCP activity** | **0** | Messages per second |
| | Server | **EtherNet/IP activity** | **0** | Messages per second |
| | | **Modbus TCP activity** | **0** | Messages per second |

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**NOTE:** The background color for the **Processor Utilization** and **Module Utilization** values varies, depending upon the percentage of utilization. If utilization is:

- 90% to 100%—background color is RED
- 80% to 89.99%—background color is YELLOW
- 0% to 79.99%—background color is GRAY

To open this page:

| Step | Action |
|---|---|
| 1 | Starting at the **Home page**, click the **Diagnostics** main menu item. The **Diagnostics** page opens. |
| 2 | On the left side of the **Diagnostics** page, select **Ethernet** →**Processor Load**. |
| 3 | If necessary, type in the HTTP web access password.<br>**NOTE:** The default password is **USER**. |

## Processor Load Parameters

The **Processor Load** page displays the following parameters for the communication module:

| Parameter | Description |
|---|---|
| Module Load: | |
| Processor Utilization | The percent of Ethernet communication module processor capacity used by the present level of communication activity. The background color of the value changes, depending on the percentage utilization. |
| I/O Scanner: | |
| EtherNet/IP Sent (writes) | The number of EtherNet/IP packets the module has sent, since the last reset, in packets/second. |
| EtherNet/IP Received (read) | The number of EtherNet/IP packets the module has received, since the last reset, in packets/second. |
| Modbus TCP Requests | The number of Modbus TCP requests the module has sent, since the last reset, in packets/second. |
| Modbus TCP Responses | The number of Modbus TCP responses the module has received, since the last reset, in packets/second. |
| I/O Adapter: | |
| EtherNet/IP Sent (writes) | The number of EtherNet/IP packets the module has sent—in the role of a local slave—since the last reset, in packets/second. |
| EtherNet/IP Received (read) | The number of EtherNet/IP packets the module has received—in the role of a local slave—since the last reset, in packets/second. |
| I/O - Module | |
| Module Capacity | The maximum number of packets that the module can process, in packets per second. |
| Module Utilization | The percentage of communication module capacity being used by the application. The background color of the value changes, depending on the percentage utilization. |
| Messaging - Client: | |
| EtherNet/IP activity | The number of I/O messages sent by the module—using the EtherNet/IP protocol—since last reset, in packets per second. |
| Modbus TCP activity | The number of I/O messages sent by the module—using the Modbus TCP protocol—since last reset, in packets per second. |
| Messaging - Server: | |
| EtherNet/IP activity | The number of I/O messages received by the module—using the EtherNet/IP protocol—since last reset, in packets per second. |
| Modbus TCP activity | The number of I/O messages received by the module—using the Modbus TCP protocol—since last reset, in packets per second. |

# Scanner Status

## Introduction

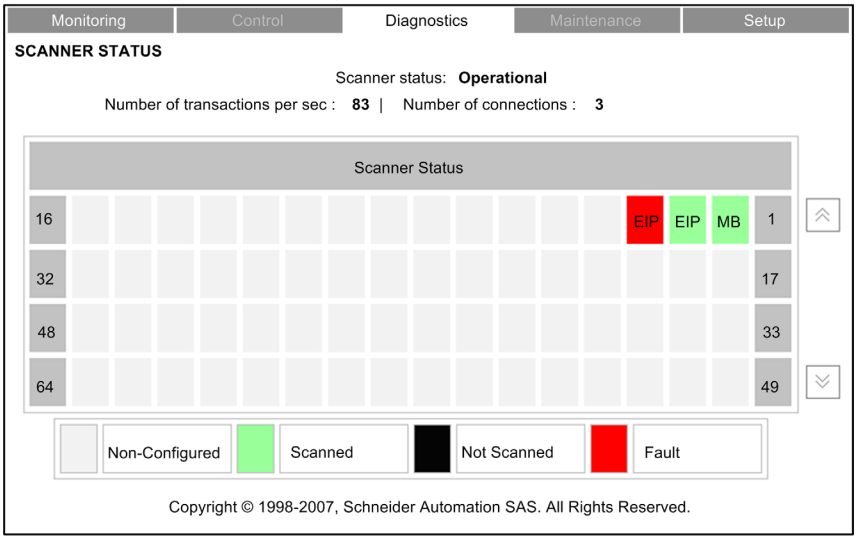
The **Scanner Status** web page displays read-only data describing the current state of the BMX NOC 0401 Ethernet communication module in its role as I/O scanner.

## Scanner Status Display

The top of the page displays the following general diagnostic information about the scanner:

- I/O scanning status
  - A value of **Operational** indicates that the values in the **Scanner Status** grid are reporting the state of scanned devices.
  - A value of **Stopped** indicates the local system is not scanning. In this case, any data that appears in the **Scanner Status** grid is meaningless.
- Number of transactions per second
- Number of connections

The **Scanner Status** web page looks like this:




In the **Scanner Status** grid, the colors that appear in each block indicate the following states for specific remote devices:

- GREEN indicates that a device is being scanned
- BLACK indicates that I/O scanning of the specific device has been intentionally disabled
- GRAY indicates an device that is not configured
- RED indicates a suspect device

**NOTE:** A green **Scanner Status** indicator in the grid can remain green for a remote scanned device after the Ethernet cable is detached from that device. This situation can occur if the health timeout value for that device is set to 0.

**NOTE:** To avoid this result—and to help promote the accurate reporting of I/O scanning health—configure an operational health timeout value in the range 1...65535 (in 1 ms increments).

The grid also indicates the protocol used to communicate with the remote device:

- MB: indicates a Modbus TCP connection
- EIP: indicates an EtherNet/IP connection

To open this page:

| Step | Action |
|---|---|
| 1 | Starting at the **Home page**, click the **Diagnostics** main menu item. The **Diagnostics** page opens. |
| 2 | On the left side of the **Diagnostics** page, select **Ethernet** →**Scanner Status**. |
| 3 | If necessary, type in the HTTP web access password.<br>**NOTE:** The default password is **USER**. |

# Messaging

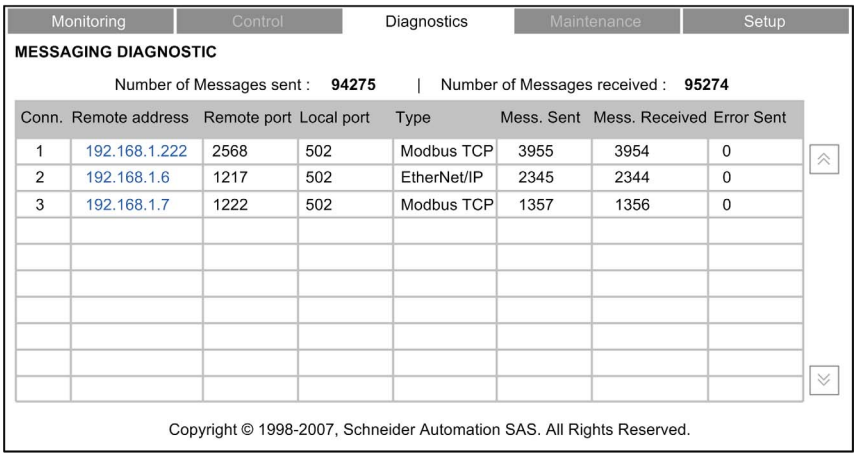
## Introduction

The **Messaging** page provides current information on the open TCP connections on port 502.

## Messaging Display

The top of the page displays the number of messages sent and received by local port 502.

The **Messaging** page looks like this:


Monitoring
Control
Diagnostics
Maintenance
Setup
MESSAGING DIAGNOSTIC
Number of Messages sent : 94275 | Number of Messages received : 95274
Conn. Remote address Remote port Local port Type Mess. Sent Mess. Received Error Sent
1 192.168.1.222 2568 502 Modbus TCP 3955 3954 0
2 192.168.1.6 1217 502 EtherNet/IP 2345 2344 0
3 192.168.1.7 1222 502 Modbus TCP 1357 1356 0
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The display grid provides the following information about each active connection:

- **Conn.:** the connection number—1 to 64
- **Remote address:** the IP address of the remote device
  **NOTE:** If the remote device includes an embedded web server, click on the **Remote address** to open that server and view the remote device's web pages.
- **Remote port:** the TCP port for the connection on the remote device
- **Local port:** the TCP port for the connection on the Ethernet communication module
- **Type:** the connection type—EtherNet/IP or Modbus TCP
- **Mess. Sent:** the number of messages transmitted over this connection
- **Mess. Received:** the number of messages received by this connection
- **Error Sent:** the number of events detected on this connection

**NOTE:**

- Following a request to close a connection, the PLC may hold the connection open in its memory for a few minutes, during which the display will reflect the open connection.
- The **Number of Messages received** is not reset after a port 502 connection is closed. Therefore, the count indicates the total number of messages that have been received since the module was started

To open this page:

| Step | Action |
|---|---|
| 1 | Starting at the **Home page**, click the **Diagnostics** main menu item. The **Diagnostics** page opens. |
| 2 | On the left side of the **Diagnostics** page, select **Ethernet** →**Messaging**. |
| 3 | If necessary, type in the HTTP web access password.<br>**NOTE:** The default password is **USER**. |

# QoS Configuration

## Introduction

The BMX NOC 0401 Ethernet communication module supports the OSI layer 3 Quality of Service (QoS) standard defined in RFC-2475. When the QoS is enabled, the module adds a *differentiated services code point* (DSCP) tag to each Ethernet packet it transmits, thereby indicating the priority of that packet.

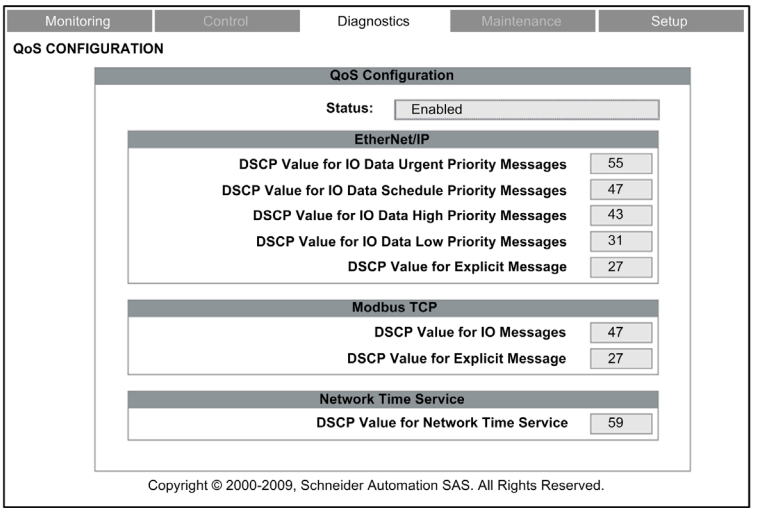
The **QoS Configuration** page displays both the:

- status of the QoS Ethernet packet tagging service—enabled or disabled, and
- the QoS service configuration settings

**NOTE:** The QoS service is enabled in the Services page, and the configuration settings are input in the QoS page, of the Unity Pro Ethernet Configuration Tool.

## QoS Configuration Display

The QoS Configuration page looks like this:




This page is read-only.

To open this page:

| Step | Action |
|---|---|
| 1 | Starting at the **Home page**, click the **Diagnostics** main menu item. The **Diagnostics** page opens. |
| 2 | On the left side of the **Diagnostics** page, select **Ethernet** →**QoS Configuration**. |
| 3 | If necessary, type in the HTTP web access password.<br>**NOTE:** The default password is **USER**. |

# Port Statistics

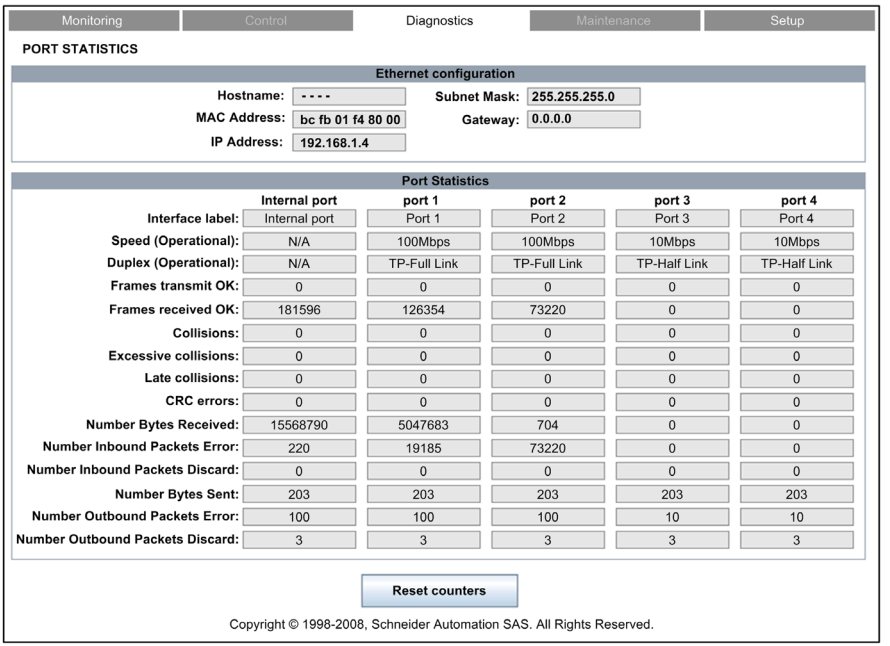
## Introduction

Use the **Port Statistics** page to display the following data for the BMX NOC 0401 Ethernet communication module:

- static IP addressing configuration data for the module, and
- dynamically generated data describing operations of the module's internal port, and each of the module's external Ethernet ports (ports 1, 2, 3 and 4)

## Port Statistics Display

The **Port Statistics** page looks like this:



Monitoring | Control | Diagnostics | Maintenance | Setup

PORT STATISTICS

**Ethernet configuration**

| | | | |
|---|---|---|---|
| Hostname: | - - - - | Subnet Mask: | 255.255.255.0 |
| MAC Address: | bc fb 01 f4 80 00 | Gateway: | 0.0.0.0 |
| IP Address: | 192.168.1.4 | | |

**Port Statistics**

| | Internal port | port 1 | port 2 | port 3 | port 4 |
|---|---|---|---|---|---|
| Interface label: | Internal port | Port 1 | Port 2 | Port 3 | Port 4 |
| Speed (Operational): | N/A | 100Mbps | 100Mbps | 10Mbps | 10Mbps |
| Duplex (Operational): | N/A | TP-Full Link | TP-Full Link | TP-Half Link | TP-Half Link |
| Frames transmit OK: | 0 | 0 | 0 | 0 | 0 |
| Frames received OK: | 181596 | 126354 | 73220 | 0 | 0 |
| Collisions: | 0 | 0 | 0 | 0 | 0 |
| Excessive collisions: | 0 | 0 | 0 | 0 | 0 |
| Late collisions: | 0 | 0 | 0 | 0 | 0 |
| CRC errors: | 0 | 0 | 0 | 0 | 0 |
| Number Bytes Received: | 15568790 | 5047683 | 704 | 0 | 0 |
| Number Inbound Packets Error: | 220 | 19185 | 73220 | 0 | 0 |
| Number Inbound Packets Discard: | 0 | 0 | 0 | 0 | 0 |
| Number Bytes Sent: | 203 | 203 | 203 | 203 | 203 |
| Number Outbound Packets Error: | 100 | 100 | 100 | 10 | 10 |
| Number Outbound Packets Discard: | 3 | 3 | 3 | 3 | 3 |

Reset counters

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Click on the **Reset counters** button to reset the counting statistics to zero.

To open this page:

| Step | Action |
|---|---|
| 1 | Starting at the **Home page**, click the **Diagnostics** main menu item. The **Diagnostics** page opens. |
| 2 | On the left side of the **Diagnostics** page, select **Ethernet** →**Switch** →**Port Statistics**. |
| 3 | If necessary, type in the HTTP web access password.<br>**NOTE:** The default password is **USER**. |

## Port Statistics Descriptions

The **Port Statistics** page displays the following parameters for each communication module port:

| Parameter | Description |
|---|---|
| Ethernet Configuration data: | |
| Hostname | The name assigned to the communication module |
| MAC Address | The factory assigned Media Access Control (MAC) address, consisting of 6 hexidecimal octet values |
| IP Address | The Internet Protocol (IP) address *(see page 65)* that has been assigned to the communication module |
| Subnet Mask | The subnet mask *(see page 65)* that has been assigned to the communication module |
| Gateway | The IP address of the remote device *(see page 65)*, if any, that serves as a gateway to the communication module |
| Port Statistics: | |
| Interface Label | Un-Initialized or Initialized |
| Speed (Operational) | Baud rate: 0, 10, 100 Mbps |
| Duplex (Operational) | Twisted Pair— Full Link, Twisted Pair—Half Link |
| Frames transmit OK: | The number of frames that have been successfully transmitted |
| Frames received OK: | The number of frames that have been successfully received |
| Collisions: | The number of times a collision between two successfully transmitted packets was detected on the link |
| Excessive collisions: | The number of times the transmitter has not been successful after 16 attempts to transmit a frame, due to repeated collisions |
| CRC errors: | The number of times a CRC (FCS) error was detected on an incoming frame |
| Number Bytes Received: | Number of inbound bytes received on the interface |
| Number Inbound Packets Error: | The number of inbound packets that contain detected errors (not included in discards) |
| Number Inbound Packets Discard: | The number of inbound packets received on the interface, but discarded |
| Number Bytes Sent: | The number of outbound bytes transmitted on the interface |
| Number Outbound Packets Error: | The number of outbound packets that contain detected errors (not included in discards) |
| Number Outbound Packets Discard: | The number of outbound packets discarded while attempting to send them |

# Redundancy

## Introduction

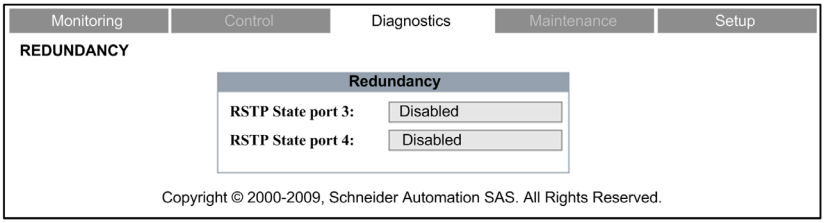
Use the **Redundancy** page to enable and disable the Rapid Spanning Tree Protocol (RSTP) for switch ports 3 and 4.

**NOTE:** Because only switch ports 3 and 4 support RSTP redundancy, use ports 3 and 4 to connect the BMX NOC 0401 Ethernet communication module to the wider network, and ports 1 and 2 for connections to local devices.

The RSTP service creates a loop-free logical network path for Ethernet devices that are part of a topology that includes redundant physical paths, and automatically restores network communication—by activating redundant links—in the event the network experiences a service interruption.

## Redundancy Display

The **Redundancy** page looks like this:




To open this page:

| Step | Action |
|---|---|
| 1 | Starting at the **Home page**, click the **Diagnostics** main menu item. The **Diagnostics** page opens. |
| 2 | On the left side of the **Diagnostics** page, select **Ethernet** →**Switch** → **Redundancy**. |
| 3 | If necessary, type in the HTTP web access password.<br>**NOTE:** The default password is **USER**. |

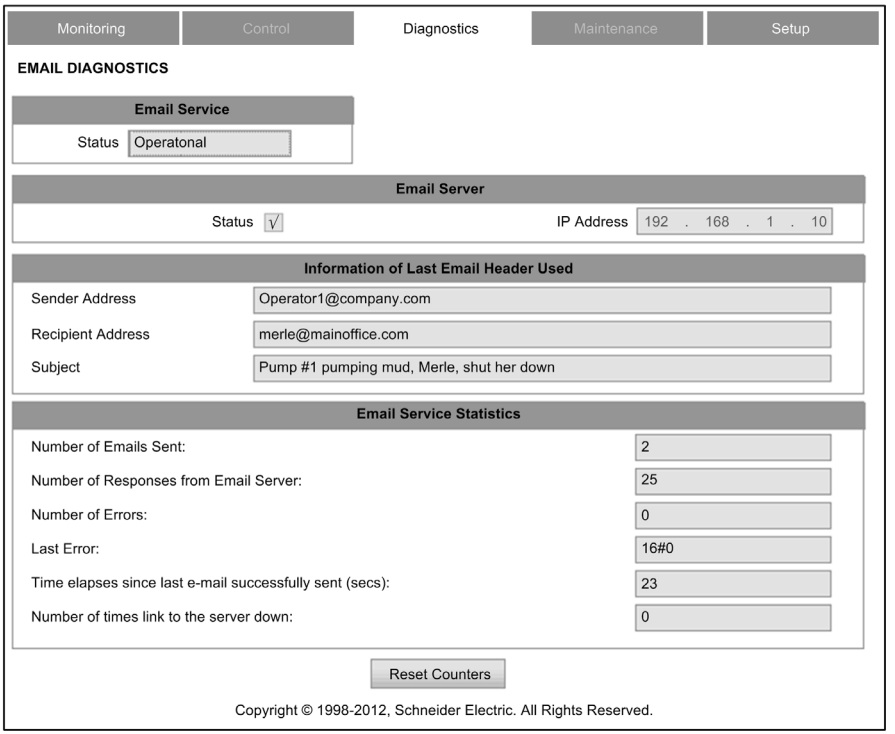
# Email Diagnostics

## Diagnosing SMTP Transmissions

Use the **SMTP Diagnostics** web page to display dynamically generated data describing the BMX NOC 0401 Ethernet communication module Email transmissions.

**NOTE:** The Email service is enabled in the **Services** page, and the configuration settings are input in the **SMTP Configuration** page of the module DTM.

The **SMTP Diagnostics** web page looks like this:




Click the **Reset Counter** button to reset to 0 the **Email Service Statistics**.

To open this page:

| Step | Action |
|---|---|
| 1 | Starting at the **Home page**, click the **Diagnostics** main menu item. The **Diagnostics** page opens. |
| 2 | On the left side of the **Diagnostics** page, select **Ethernet** →**SMTP Diagnostics**. |
| 3 | If necessary, type in the HTTP web access password.<br>**NOTE:** The default password is **USER**. |

## Email diagnostic Parameters

Electronic mail notification service parameters include the following:

| Parameter | Description |
|---|---|
| Email Service: | |
| Status | The status of this service in the Ethernet communication module:<br>● Operational<br>● Service Disabled |
| Email Server: | |
| Status | The connection status between Ethernet communication module and the SMTP server:<br>● check mark = connected<br>● no check mark = not connected<br>**NOTE:** Status is checked at start-up and at least every 30 minutes after start-up. |
| IP Address | IP address of the SMTP server |
| Information of Last Email Header Used: | |
| Sender Address: | Content of the *From* field in the last used Email header |
| Recipient Address: | Content of the *To* field in the last used Email header |
| Subject: | Content of the *Subject* field in the last used Email header |
| Email Service Statistics: | |
| Number of Emails Sent | Total number of Emails sent and successfully acknowledged by the SMTP server. |
| Number of Responses from Email Server | Total number of responses received from the SMTP server |
| Number of Errors | Total number of Emails that either:<br>● could not be sent<br>● were sent but were not successfully acknowledged by the SMTP server |
| Last Error | Hexadecimal code describing the reason for the last unsuccessful Email transmission *(see page 405)*. The value “0” indicates no unsuccessful transmissions. |
| Time elapses since last Email successfully sent (sec) | Counts the number of seconds since the last Email was successfully sent. |
| Number of times link to the server down | Number of times the SMTP server could not be reached. (Link checked every 30 minutes.) |

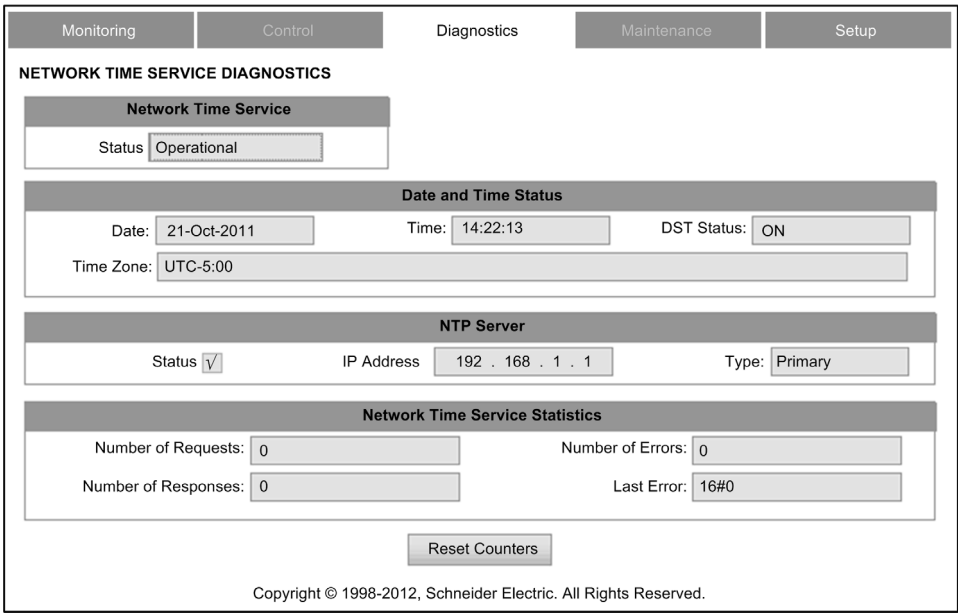
# Network Time Service Diagnostics

## Diagnosing the Network Time Service

Use the **Network Time Service Diagnostic** web page to display dynamically generated data describing the operation of the network time protocol (NTP) service that you configured in the Network Time Service page *(see page 97)* in Unity Pro.

**NOTE:** The Email service is enabled in the **Services** page, and the configuration settings are input in the **Network Time Service Configuration** page of the module DTM.

The **NTP Diagnostics** web page looks like t his:




Click the **Reset Counter** button to reset to 0 the **Network Time Service Statistics**.

To open this page:

| Step | Action |
|---|---|
| 1 | Starting at the **Home page**, click the **Diagnostics** main menu item. The **Diagnostics** page opens. |
| 2 | On the left side of the **Diagnostics** page, select **Ethernet** →**NTP Diagnostics**. |
| 3 | If necessary, type in the HTTP web access password.<br>**NOTE:** The default password is **USER**. |

## Network Time Service Diagnostic Parameters

Time synchronization service parameters are in the table:

| Parameter | Description |
|---|---|
| Network Time Service: | |
| Status | Operational status of the service in the module:<br>● Operational<br>● Service Disabled |
| Date and Time Status: | |
| Date: | System date |
| Time: | System time<br>**NOTE:** Red text indicates the network time server is not available. |
| DST Status | The actual working status of the automatic daylight savings service:<br>● ON = automatic adjustment of daylight savings is enabled and the current date and time reflect the daylight savings time adjustment<br>● OFF = automatic adjustment of daylight savings is disabled; or automatic adjustment of daylight savings is enabled, but the current date and time may not reflect the daylight savings time adjustment |
| Time Zone | Time zone plus or minus Universal Time, Coordinated (UTC) |
| NTP Server: | |
| Status | Connection status of the NTP server:<br>● check mark = the NTP server is reachable<br>● no check mark = the NTP server is not reachable |
| IP Address | The IP address of the NTP server |
| Type | The NTP server currently active:<br>● Primary<br>● Secondary |
| Network Time Service Statistics: | |
| Number of Requests: | Total number of client requests sent to the NTP server |
| Number of Responses: | Total number of server responses sent from the NTP server |
| Number of Errors: | Total number of unanswered NTP requests |
| Last Error | Last detected error code received from the NTP client:<br>● 0: good NTP configuration<br>● 1: late NTP server response (can be caused by excessive network traffic or server overload)<br>● 2: NTP not configured<br>● 3: invalid NTP parameter setting<br>● 4: NTP component disabled<br>● 7: unrecoverable NTP transmission<br>● 9: invalid NTP server IP address<br>● 15: invalid syntax in the custom time zone rules file |

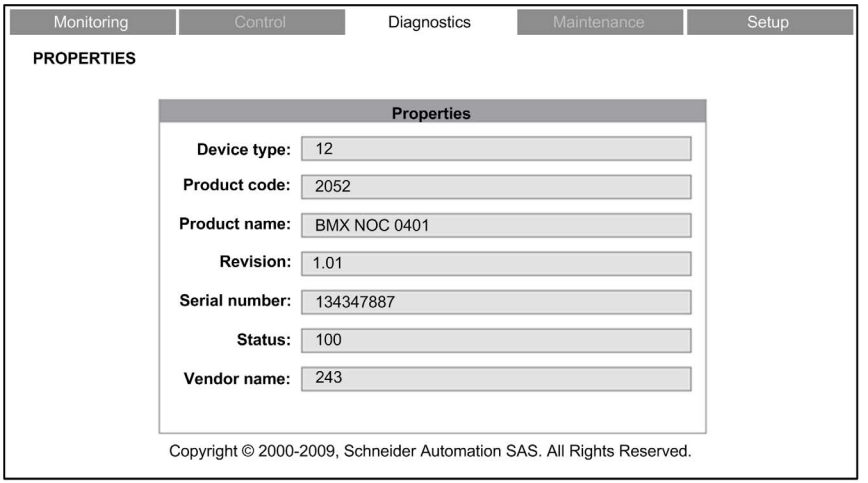
# Properties

## Introduction

The **Properties** web page displays read-only data describing the particular BMX NOC 0401 Ethernet communication module installed in your system.

## Properties Display

The **Properties** page looks like this:




To open this page:

| Step | Action |
|---|---|
| 1 | Starting at the **Home page**, click the **Diagnostics** main menu item. The **Diagnostics** page opens. |
| 2 | On the left side of the **Diagnostics** page, select **Properties**. |
| 3 | If necessary, type in the HTTP web access password.<br>**NOTE:** The default password is **USER**. |

# Appendices

## What Is in This Appendix?

The appendix contains the following chapters:


| Chapter | Chapter Name | Page |
|---|---|---|
| A | Detected Error Codes | 391 |
| B | CIP General Status Codes | 399 |
| C | Modbus Exception Response Codes | 403 |
| D | Email Detected Error Response Codes | 405 |

# Appendix A
## Detected Error Codes

### Overview

This chapter contains a list of codes that describe the status of Ethernet communication module messages.

### What Is in This Chapter?

This chapter contains the following topics:


| Topic | Page |
|---|---|
| EtherNet/IP Implicit or Explicit Messaging Detected Error Codes | 392 |
| Explicit Messaging: Communication and Operation Reports | 395 |

# EtherNet/IP Implicit or Explicit Messaging Detected Error Codes

## Introduction

If a DATA_EXCH function block does not execute an EtherNet/IP explicit message, Unity Pro returns a hexadecimal detected error code. The code can describe an EtherNet/IP detected error.

## EtherNet/IP Detected Error Codes

EtherNet/IP hexadecimal detected error codes include:

| Detected Error Code | Description |
|---|---|
| 16#800D | Timeout on the explicit message request |
| 16#8012 | Bad device |
| 16#8015 | Either:<br>● Nor resources to handle the message, or<br>● Internal detected error: no buffer available, no link available, impossible to send to the TCP task |
| 16#8018 | Either:<br>● Another explicit message for this device is in progress, or<br>● TCP connection or encapsulation session in progress |
| 16#8030 | Timeout on the Forward_Open request |
| **Note**: The following 16#81xx detected errors are Forward_Open response detected errors that originate at the remote target and are received via the CIP connection. | |
| 16#8100 | Connection in use or duplicate Forward_Open |
| 16#8103 | Transport class and trigger combination not supported |
| 16#8106 | Ownership conflict |
| 16#8107 | Target connection not found |
| 16#8108 | Invalid network connection parameter |
| 16#8109 | Invalid connection size |
| 16#8110 | Target for connection not configured |
| 16#8111 | RPI not supported |
| 16#8113 | Out of connections |
| 16#8114 | Vendor ID or product code mismatch |
| 16#8115 | Product type mismatch |
| 16#8116 | Revision mismatch |
| 16#8117 | Invalid produced or consumed application path |
| 16#8118 | Invalid or inconsistent configuration application path |
| 16#8119 | Non-Listen Only connection not opened |

| Detected Error Code | Description |
|---|---|
| 16#811A | Target object out of connections |
| 16#811B | RPI is smaller than the production inhibit time |
| 16#8123 | Connection timed out |
| 16#8124 | Unconnected request timed out |
| 16#8125 | Parameter detected error in unconnected request and service |
| 16#8126 | Message too large for unconnected_send service |
| 16#8127 | Unconnected acknowledge without reply |
| 16#8131 | No buffer memory available |
| 16#8132 | Network bandwidth not available for data |
| 16#8133 | No consumed connection ID filter available |
| 16#8134 | Not configured to send scheduled priority data |
| 16#8135 | Schedule signature mismatch |
| 16#8136 | Schedule signature validation not possible |
| 16#8141 | Port not available |
| 16#8142 | Link address not valid |
| 16#8145 | Invalid segment in connection path |
| 16#8146 | Detected error in Forward_Close service connection path |
| 16#8147 | Scheduling not specified |
| 16#8148 | Link address to self invalid |
| 16#8149 | Secondary resources unavailable |
| 16#814A | Rack connection already established |
| 16#814B | Module connection already established |
| 16#814C | Miscellaneous |
| 16#814D | Redundant connection mismatch |
| 16#814E | No more user-configurable link consumer resources: the configured number of resources for a producing application has reached the limit |
| 16#814F | No more user-configurable link consumer resources: there are no consumers configured for a producing application to use |
| 16#8160 | Vendor specific |
| 16#8170 | No target application data available |
| 16#8171 | No originator application data available |
| 16#8173 | Not configured for off-subnet multicast |
| 16#81A0 | Detected error in data assignment |
| 16#81B0 | Optional object state detected error |

| Detected Error Code | Description |
|---|---|
| 16#81C0 | Optional device state detected error |
| **Note**: All 16#82xx detected errors are register session response detected errors. | |
| 16#8200 | Target device does not have sufficient resources |
| 16#8208 | Target device does not recognize message encapsulation header |
| 16#820F | Reserved or unknown detected error from target |

# Explicit Messaging: Communication and Operation Reports

## Overview

Communication and operation reports are part of the management parameters.

**NOTE:** It is recommended that communication function reports be tested at the end of their execution and before the next activation. On cold start-up, confirm that all communication function management parameters are checked and reset to 0.

**NOTE:** It may be helpful to use the %S21 to examine the first cycle after a cold or warm start. For more information, refer to Unity Pro online help for %S21.

## Communication Report

This report is common to every explicit messaging function. It is significant when the value of the activity bit switches from 1 to 0. The reports with a value between 16#01 and 16#FE concern errors detected by the processor that executed the function.

The different values of this report are indicated in the following table:

| Value | Communication report (least significant byte) |
|---|---|
| 16#00 | Correct exchange |
| 16#01 | Exchange stop on timeout |
| 16#02 | Exchange stop on user request (CANCEL) |
| 16#03 | Incorrect address format |
| 16#04 | Incorrect destination address |
| 16#05 | Incorrect management parameter format |
| 16#06 | Incorrect specific parameters |
| 16#07 | Error detected in sending to the destination |
| 16#08 | Reserved |
| 16#09 | Insufficient receive buffer size |
| 16#0A | Insufficient send buffer size |
| 16#0B | No system resources: the number of simultaneous communication EFs exceeds the maximum that can be managed by the processor |
| 16#0C | Incorrect exchange number |
| 16#0D | No telegram received |
| 16#0E | Incorrect length |
| 16#0F | Telegram service not configured |
| 16#10 | Network module missing |
| 16#11 | Request missing |
| 16#12 | Application server already active |

| Value | Communication report (least significant byte) |
|---|---|
| 16#13 | UNI-TE V2 transaction number incorrect |
| 16#FF | Message refused |

**NOTE:** The function can detect a parameter error before activating the exchange. In this case the activity bit remains at 0, and the report is initialized with values corresponding to the detected error.

## Operation Report

This report byte is specific to each function, and specifies the result of the operation on the remote application:

| Value | Operation report (most significant byte) |
|---|---|
| 16#05 | Length mismatch (CIP) |
| 16#07 | Bad IP address |
| 16#08 | Application error |
| 16#09 | Network is down |
| 16#0A | Connection reset by peer |
| 16#0C | Communication function not active |
| 16#0D | • Modbus TCP: transaction timed out<br>• EtherNet/IP: request timeout |
| 16#0F | No route to remote host |
| 16#13 | Connection refused |
| 16#15 | • Modbus TCP: no resources<br>• EtherNet/IP: no resources to handle the message; or an internal detected error; or no buffer available; or no link available; or cannot send message |
| 16#16 | Remote address not allowed |
| 16#18 | • Modbus TCP: concurrent connections or transactions limit reached<br>• EtherNet/IP: TCP connection or encapsulation session in progress |
| 16#19 | Connection timed out |
| 16#22 | Modbus TCP: invalid response |
| 16#23 | Modbus TCP: invalid device ID response |
| 16#30 | • Modbus TCP: remote host is down<br>• EtherNet/IP: connection open timed out |
| 16#80...16#87: Forward_Open response detected errors: | |
| 16#80 | Internal detected error |
| 16#81 | Configuration detected error: the length of the explicit message, or the RPI rate, needs to be adjusted |
| 16#82 | Device detected error: target device does not support this service |
| 16#83 | Device resource detected error: no resource is available to open the connection |

| Value | Operation report (most significant byte) |
|---|---|
| 16#84 | System resource evebt: unable to reach the device |
| 16#85 | Data sheet detected error: incorrect EDS file |
| 16#86 | Invalid connection size |
| 16#90...16#9F: Register session response detected errors: | |
| 16#90 | Target device does not have sufficient resources |
| 16#98 | Target device does not recognize message encapsulation header |
| 16#9F | Unknown detected error from target |

# Appendix B
## CIP General Status Codes

### CIP General Status Codes

**NOTE:** Taken by permission from *The CIP Networks Library, Volume 1*, Common Industrial Protocol (CIP™), Edition 3.6, April 2009.

The following table lists the status codes that may be present in the general status code field of a detected error response message. Note that the extended code field is available for use in further describing any general status code. Extended status codes are unique to each general status code within each object. Each object manages the extended status values and value ranges (including vendor specific). All extended status values are reserved unless otherwise indicated within the object definition.

| General Status Code (in hex) | Status Name | Description of Status |
|---|---|---|
| 00 | Success | Service was successfully performed by the object specified. |
| 01 | Connection unsuccessful | A connection related service was unsuccessful along the connection path. |
| 02 | Resource unavailable | Resources needed for the object to perform the requested service were unavailable. |
| 03 | Invalid parameter value | See status code 0x20, which is the preferred value to use for this condition. |
| 04 | Path segment error | The path segment identifier or the segment syntax was not understood by the processing node. Path processing stops when a path segment error is detected. |
| 05 | Path destination unknown | The path is referencing an object class, instance, or structure element that is not known or is not contained in the processing node. Path processing stops when a path destination unknown error is detected. |
| 06 | Partial transfer | Only part of the expected data was transferred. |
| 07 | Connection lost | The messaging connection was lost. |
| 08 | Service not supported | The requested service was not implemented or was not defined for this object class/instance. |
| 09 | Invalid attribute value | Invalid attribute data detected. |
| 0A | Attribute list error | An attribute in the Get_Attribute_List or Set_Attribute_List response has a non-zero status. |

| General Status Code (in hex) | Status Name | Description of Status |
|---|---|---|
| 0B | Already in requested mode/state | The object is already in the mode/state being requested by the service. |
| 0C | Object state conflict | The object cannot perform the requested service in its current mode/state. |
| 0D | Object already exists | The requested instance of object to be created already exists. |
| 0E | Attribute not settable | A request to modify a non-modifiable attribute was received. |
| 0F | Privilege violation | A permission/privilege check was unsuccessful. |
| 10 | Device state conflict | The device's current mode/state prohibits the execution of the requested service. |
| 11 | Reply data too large | The data to be transmitted in the response buffer is larger than the allocated response buffer. |
| 12 | Fragmentation of a primitive value | The service specified an operation that is going to fragment a primitive data value, i.e., half a REAL data type. |
| 13 | Not enough data | The service did not supply enough data to perform the specified operation. |
| 14 | Attribute not supported | The attribute specified in the request is not supported. |
| 15 | Too much data | The service supplied more data than was expected. |
| 16 | Object does not exist | The object specified does not exist in the device. |
| 17 | Service fragmentation sequence not in progress | The fragmentation sequence for this service is not currently active for this data. |
| 18 | No stored attribute data | The attribute data of this object was not saved prior to the requested service. |
| 19 | Store operation unsuccessful | The attribute data of this object was not saved due to an unsuccessful attempt. |
| 1A | Routing unsuccessful, request packet too large | The service request package was too large for transmission on a network in the path to the destination. The routing device was forced to abort the service. |
| 1B | Routing unsuccessful, response packet too large | The service response packet was too large for transmission on a network in the path from the destination. The routing device was forced to abort the service. |
| 1C | Missing attribute list entry data | The service did not supply an attribute in a list of attributes that was needed by the service to perform the requested behavior. |
| 1D | Invalid attribute value list | The service is returning the list of attributes supplied with status information for those attributes that were invalid. |
| 1E | Embedded service error | An embedded service resulted in a detected error. |

| General Status Code (in hex) | Status Name | Description of Status |
|---|---|---|
| 1F | Vendor specific error | A vendor specific error has been detected. The additional code field of the error response defines the particular error encountered. Use this general code only when none of the codes presented in this table or within an object class definition accurately reflect the detected error. |
| 20 | Invalid parameter | A parameter associated with the request was invalid. This code is used when a parameter does not meet the requirements of this specification and/or the requirements defined in an application object specification. |
| 21 | Write-once value or medium already written | An attempt was made to write to a write-once medium (e.g., WORM drive, PROM) that has already been written, or to modify a value that cannot be changed once established. |
| 22 | Invalid reply received | An invalid reply is received (e.g., reply service code does not match the request service code, or reply message is shorter than the minimum expected reply size). This status code an serve for other causes of invalid replies. |
| 23 | Buffer overflow | The message received is larger than the receiving buffer can handle. The entire message was discarded. |
| 24 | Message format error | The format of the received message is not supported by the server. |
| 25 | Key failure in path | The key segment that was included as the first segment in the path does not match the destination module. The object specific status indicates which part of the key check was unsuccessful. |
| 26 | Path size invalid | The size of the path that was sent with the service request is either not large enough to allow the request to be routed to an object or too much routing data was included. |
| 27 | Unexpected attribute in list | An attempt was made to set an attribute that is not able to be set at this time. |
| 28 | Invalid member ID | The member ID specified in the request does not exist in the specified class/instance/attribute. |
| 29 | Member not settable | A request to modify a non-modifiable member was received. |
| 2A | Group 2 only server — general error | This detected error code may only be reported by DeviceNet group 2 only servers with 4 Kb or less code space and only in place of service not supported, attribute not support, or attribute not settable. |
| 2B | Unknown Modbus error | A CIP to Modbus translator received an unknown Modbus exception code. |
| 2C | Attribute not gettable | A request to read a non-readable attribute was received. |
| 2D - CF | – | Reserved by CIP for future extensions. |
| D0 - FF | Reserved for object class and service errors | This range of detected error codes is used to indicate object class specific detected errors. Use this range only when none of the codes presented in this table accurately reflect the error that is detected. |

# Appendix C
## Modbus Exception Response Codes

### MODBUS Exception Response Codes

The MODBUS exception response codes include the following:

| Status | | Response | Description |
|---|---|---|---|
| Hex) | (Dec) | | |
| 0x8101 | 33025 | Illegal Function | The function code received in the query is not an allowable action for the server (or slave). This may be because the function code is only applicable to newer devices, and was not implemented in the unit selected. It could also indicate that the server (or slave) is in the wrong state to process a request of this type. This code is also returned when attempting to write to a read-only attribute. |
| 0x8102 | 33026 | Illegal Data Address | The data address received in the query is not an allowable address for the server (or slave). More specifically, the combination of reference number and transfer length is invalid. |
| 0x8103 | 33027 | Illegal Data Value | A value contained in the query data field is not an allowable value for server (or slave). This indicates an invalid request structure. It specifically does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, because the MODBUS protocol does not test the significance of any particular register value. |
| 0x8104 | 33028 | Slave Device Failure | An unrecoverable event occurred while the server (or slave) was attempting to perform the requested action. |
| 0x8105 | 33029 | Acknowledge | Specialized use in conjunction with programming commands: The server (or slave) has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned so that a timeout in the client (or master) will not occur. The client (or master) can next send a Poll Program Complete message to determine if processing is completed. |
| 0x8106 | 33030 | Slave Device Busy | Specialized use in conjunction with programming commands: The server (or slave) is engaged in processing a long–duration program command. The client (or master) should retransmit the message later when the server (or slave) is free. |
| 0x8107 | 33031 | Negative Acknowledge | Specialized use in conjunction with programming commands: The request attempts to initiate a program function that is not supported by the server (slave). |

| Status | | Response | Description |
|---|---|---|---|
| Hex) | (Dec) | | |
| 0x8108 | 33032 | Memory Parity Error | Specialized use in conjunction with function codes 20 and 21 and reference type 6, indicating that the extended file area did not pass a consistency check. |
| 0x810A | 33034 | Gateway Path Unavailable | Specialized use in conjunction with gateways, indicates that the gateway was unable to allocate an internal communication path from the input port to the output port for processing the request. Usually means that the gateway is misconfigured or overloaded. |
| 0x810B | 33035 | Gateway Target Device Failed to Respond | Specialized use in conjunction with gateways, indicates that no response was obtained from the target device. Usually means that the device is not present on the network. |

The preceding MODBUS exception response codes are derived from the *MODBUS Application Protocol Specification V1.1b* as distributed by the Modbus Organization, Inc. at http://www.Modbus-IDA.com.

# Appendix D
# Email Detected Error Response Codes

## Electronic Mail Notification Service Detected Error Response Codes

### SMTP Codes

The following codes are available only on the Unity Pro DTM and web page diagnostic screens for the electronic mail notification service:

| Code (hex) | Description |
|---|---|
| 5100 | Internal error detected |
| 5101 | SMTP component not operational |
| 5102 | Mail header not configured |
| 5103 | Invalid mail header value detected (1, 2, or 3) |
| 5104 | Cannot connect to SMTP server |
| 5105 | Error detected during transmitting content of email body to SMTP server |
| 5106 | Closing SMTP connection with the server returned a detected error message |
| 5107 | SMTP HELO request unsuccessful |
| 5108 | SMTP MAIL request unsuccessful — SMTP server may require authentication |
| 5109 | SMTP RCPT request unsuccessful |
| 510A | No recipient accepted by the SMTP server |
| 510B | SMTP DATA request unsuccessful |
| 510C | Send email request contains an invalid length |
| 510D | Authentication unsuccessful |
| 510E | A reset component request was received while the connection was open |

# Glossary

## D

**DTM**

(*device type manager*) A DTM is a device driver running on the host PC. It provides a unified structure for accessing device parameters, configuring and operating the devices, and diagnosing events. DTMs can range from a simple Graphical User Interface for setting device parameters to a highly sophisticated application capable of performing complex real-time calculations for diagnosis and maintenance purposes. In the context of a DTM, a device can be a communications module or a remote device on the network.

## E

**Explicit Messaging**

TCP/IP-based messaging for Modbus TCP and EtherNet/IP. It is used for point-to-point, client/server messages that include both data—typically unscheduled information between a client and a server—and routing information. In EtherNet/IP, Explicit Messaging is considered Class 3 type messaging, and can be connection-based or connectionless.

## R

**RPI**

*(requested packet interval)* The time period between cyclic data transmissions requested by the Scanner. EtherNet/IP devices will publish data at the rate specified by the RPI assigned to them by the Scanner. Modbus TCP devices will receive message requests from the Scanner at each RPI.

## T

**trap**

A trap is an event directed by an SNMP agent that indicates either:

- a change has occurred in the status of an agent, or
- an unauthorized SNMP manager device has attempted to get data from, or change data on, an SNMP agent

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